Factory
MANAGEMENT AND MAINTENANCE

Vol. 94, No. 9 — SEPTEMBER, 1936

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Factory Management and Maintenance is a consolidation of *Factory and Industrial Management* (including *"Factory"*) and *Maintenance Engineering*

Price 35c. a copy. Subscription rates—United States, Canada, Mexico and Central and South American countries, $3 a year. All other countries, $4 a year or 16 shillings. Cable address "McGrawhill, New York." Member of A.B.P. Member A.B.C. Copyright, 1936, by McGraw-Hill Publishing Co., Inc. Publication office, 99–129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42d Street, New York, N. Y.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W. C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta.

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Factory Management and Maintenance. September, 1936. Vol. 94, No. 9. Published monthly. McGraw-Hill Publishing Company, Inc. Publication office, 99–129 North Broadway, Albany, N. Y. Editorial and executive offices, 330 West 42d Street, New York, N. Y. Application for entry as second-class matter at Albany, N. Y., pending. Printed in U. S. A.

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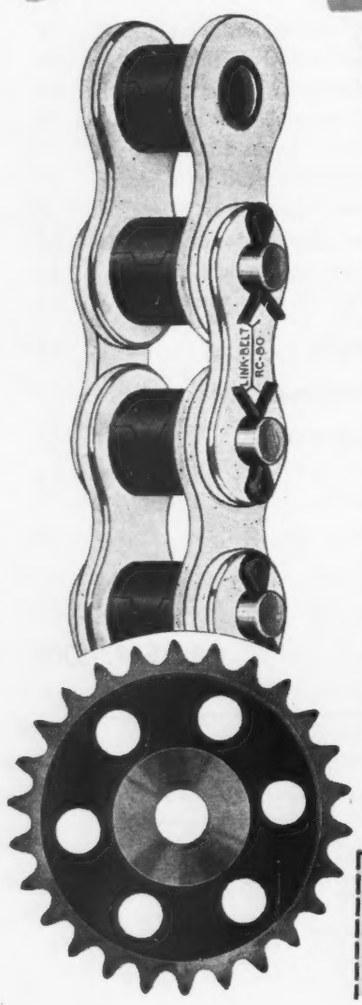

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Factory
MANAGEMENT AND MAINTENANCE

L. C. MORROW
Editor

An Effective Triple Alliance

►It is not unusual for industry to realize suddenly that a new principle or procedure has crystallized. A recent example is industry's recognition of the inherent relationship of plant layout, motion economy, and materials handling.

Any plant that undertakes to reduce production costs is certain to settle upon at least one of these three as a potential for important savings. The plant that does a thorough job of cost cutting will not fail to co-ordinate all three.

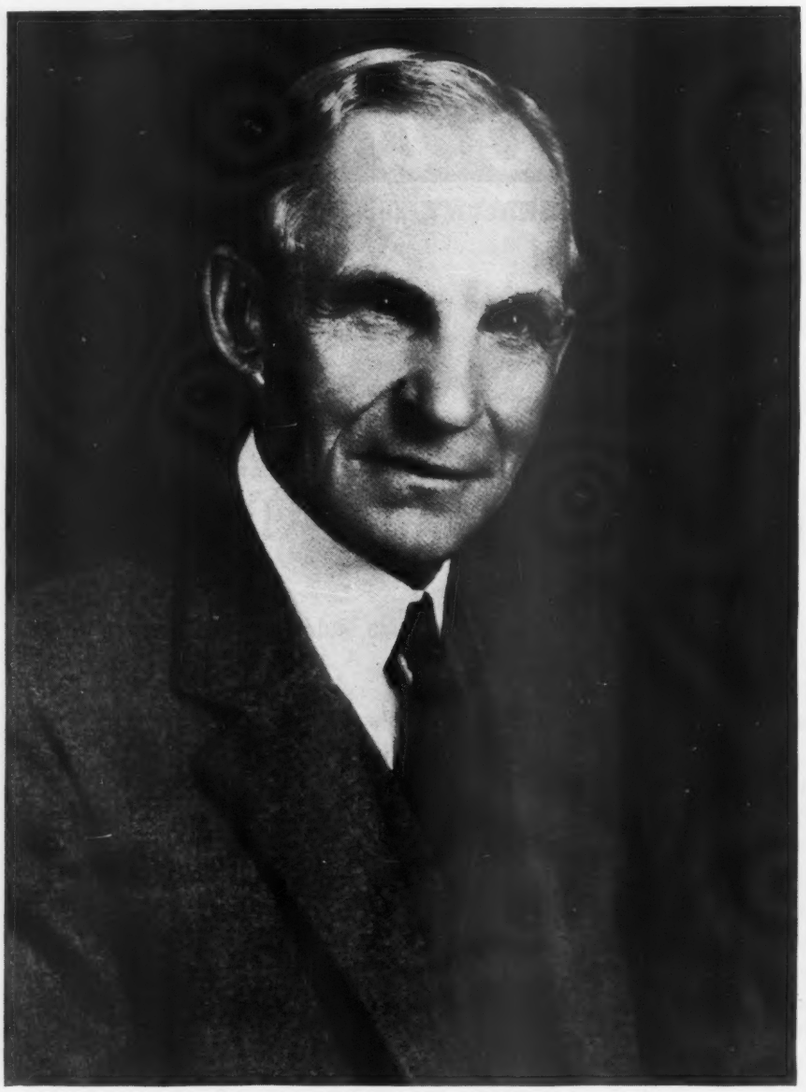
Motion economy calls for the least movement of people and materials commensurate with effective manufacture. It is impossible to have minimum movement of either people or materials without the proper arrangement of equipment, and without the conservation of operator time and motion by means of mechanical handling.

These statements may be trite. But the job is not. Nor is it ever finished. New methods and new equipment for both production and handling make plant layout a continuing job. The automobile plants furnish an extreme example that proves the statement.

For any but the simplest manufacture, the plant layout job should not be approached without recognizing that the entire plant operation is involved. An examination of the whole production procedure must be made, basic principles determined, and an infinite amount of detail followed through.

Before the task has been finished, a complete analysis of equipment replacement may have been called for—or a revision of the wage payment method—or extensive changes in the factory paper work—or a recasting of the supervisory personnel and their assignments.

In spite of all these intricacies, there have been numerous cases wherein the new layout paid for itself in short time and went ahead to add to profit. The best of these cases emphasize the inherent relationship of motion economy and the handling of materials to plant layout and prove the futility of attempting to apply any one without also applying the other two.



You cannot spread prosperity by spreading the existing supply of wealth — usable goods — in a thinner and always thinner layer across all the people

•

It is silly to talk about reducing production and raising prices as a way to prosperity

•

Only by making things can we have enough things for everybody

•

We must make better goods less expensively. And we must pay people enough in wages so that they can afford to buy the things they make

•

Modern machinery makes employment by bringing manufactured goods down to a price within the reach of the buying public

•

Industry is doing more right now to solve the problem of farm surpluses and to restore rural purchasing power than any other single influence

Industry

ECONOMIC plenty has been more wordily discussed during the past few years than at any time certainly since the years when the national issues were the full dinner pail *versus* the cross of gold. Idealists, theorists, politicians, and crackpots have all aired their divergent views. In this welter of words confusion has been bred, and uncertainty.

Many a business man who felt sure that he was doing his modest best, not only for himself and his family but also for his employees and for the social welfare of the general public, has wondered whether after all he was out of step with progress. As the theorists have failed to bring any perceptible improvement in a situation, and as he has seen the resumption of industrial activity brought about by the forces of natural rather than artificial means of recovery, there has come a greater assurance that what business seeks to accomplish is just as sound and basic as ever it was. But many a business man's thinking has been left somehow vague and unsure after all the confusion.

Throughout the entire period of economic upset, both that of the hectic financial boom of the twenties and that of the depression of the thirties, Henry Ford has stood out as one manufacturer who has never been shaken from his firm footing on solid ground. His thinking has always been basic. His idea has always been to produce better automobiles at lower costs, and to do it by such means that his workers would have incomes ample to buy much more than the bare needs of subsistence.

In his simple, straightforward program there have been no forgotten men because he has never for an instant lost sight of one fundamen-

Must Make More of Everything

An authorized interview with

HENRY FORD

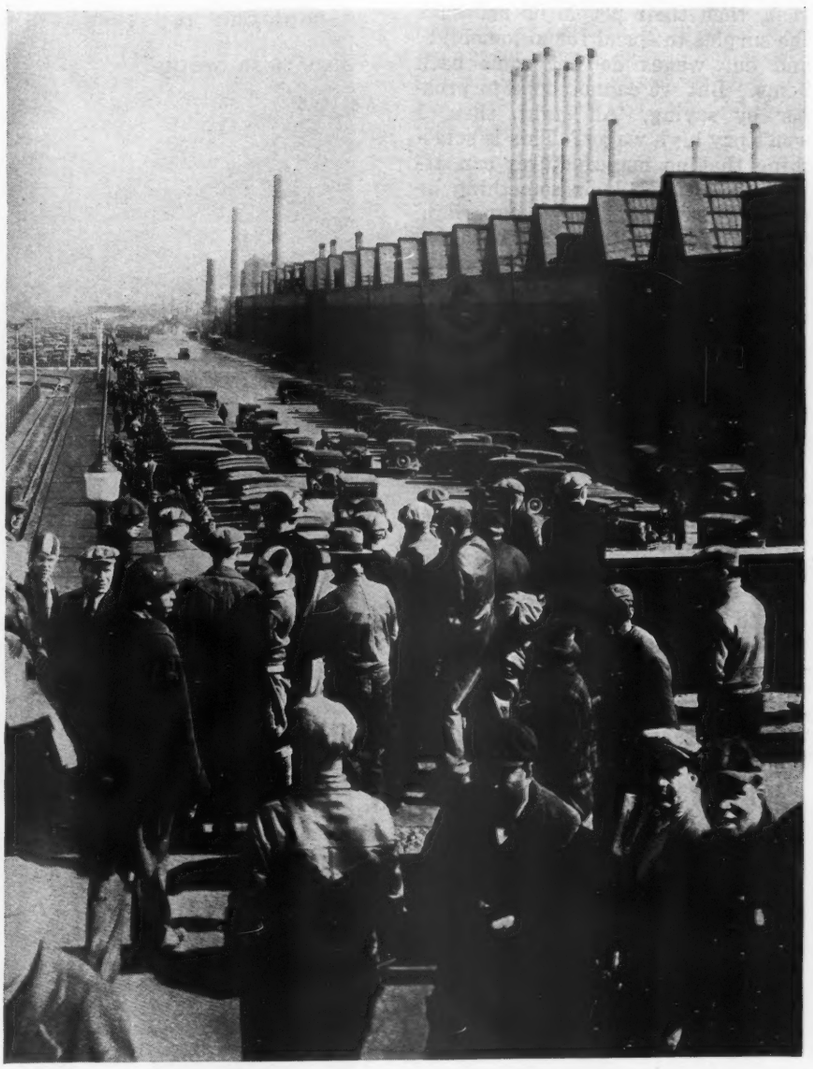
by ARTHUR VAN VLISSINGEN, JR.
Consulting Editor

tal principle. He has kept always in the front of his mind that only by moving forward along the whole economic front, by making his product accessible to the greatest number of people, and by providing his own workers with wages adequate to make them active buyers in the nation's markets, could he hope to prosper. And his idea of prospering is not the financial idea of getting rich, but the producer's idea of making ever more and better goods which the public will eagerly buy at a price low enough to make mass production possible and profitable.

"Real wealth is usable goods, not money," declares Mr. Ford. "Keep that idea always in mind. Then you can never be misled by false economic thinking. When you think in terms of money instead of goods, you confuse real wealth with the financier's ideas, which have nothing to do with wealth. The financier tries to make money, but the manufacturer makes wealth. Finance and financially controlled distribution often get between the manufacturer and the public in such a way that they hinder his production and obstruct the flow of his product to the public for which he makes it. Even though they thereby succeed in making money for themselves, this money is not wealth but is actually the opposite.

"The individual manufacturer's formula that brings prosperity to everyone, himself included, can be reduced to a few rules which are absolutely simple. *He must make a product so good that people need it and want it. He must make it so economically that people can afford to buy it. He must pay his workers wages so liberal that they can be buyers of the things they need.*

"It makes no difference to me



"The only right wages are those that permit the worker to live well enough the year around to maintain his self-respect, to have enough income so that he can be a good consumer as well as a good producer"

whether our employees buy Ford automobiles or not. Suppose that instead of using their wages for Ford cars they spend their money on clothing and on new homes. What of it? This means that the wool growers and the textile workers and the clothing workers, the nurserymen and building mechanics and building materials workers, will have employment and wages. And if our automobiles are good enough value, we shall sell enough to these people to keep our production going ahead.

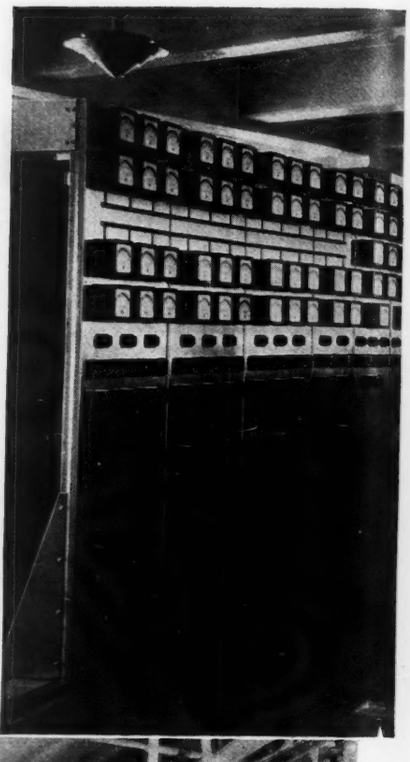
"There is just one way in which such a program can be clogged up. If the employers in industries that get the money earned in our plants do not pay fair wages—if they do not give enough employment in the year, then their people do not have the surplus to spend for automobiles, and our wages do not come back home. But we cannot hope to prosper by saying, 'All right, then, I won't pay high wages.' This is something that no manufacturer can afford to lag in. It is something he must insist on among his superiors. Buying from an industry that does not pay good wages is the next worst thing to skimping on wages in our own factories.

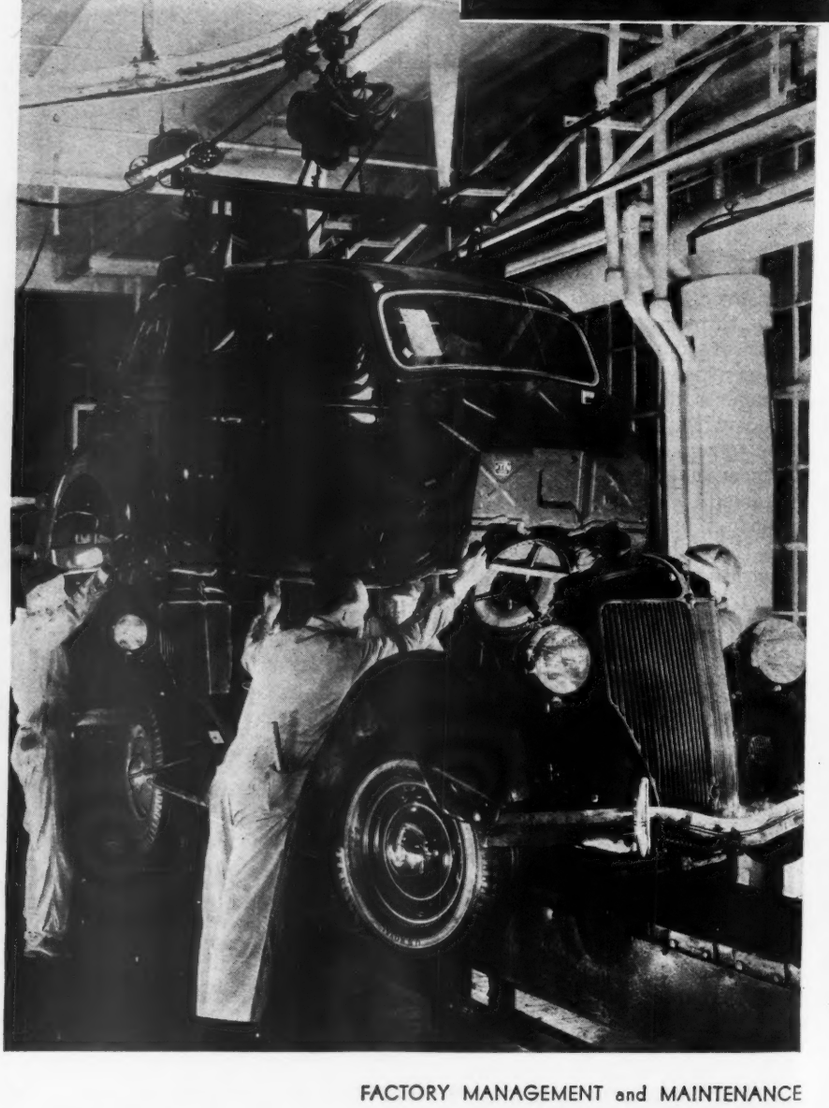
Not Too Much, But Too Little

"This idea that we have produced too much is all wrong. This country has never produced within 20 per cent of its production capacity or within 40 per cent of what it would require now if everyone could earn what he needs. How many people do you know who have as many suits of clothing as they would like to have, or as many bathrooms in their homes as they need for comfort? Or for that matter, enough of anything to satisfy them except the bare necessities? What they need is more of practically everything that industry can produce.

"Only by making things can we have enough things for everybody. To get enough of everything, everyone must produce just as much as he can. This does not, of course, mean that we should within the next year double or triple the output of Ford automobiles, because everything must go along together—no one commodity must upset the balance. But it does mean that each producer should keep searching for ways to make his own product better and less expensive, thus bringing into existence an always larger group of people who will want and can afford what is made. Then we and other automobile producers can sell more and more cars.

"We need the 8-hour day in industry, and good wages for the 8 hours. Some day the 6-hour day or even the 5-hour day will come. But not yet . . . Before we can reach the shorter work day, we must learn to produce so that we cannot only reduce prices but also raise wages"





"Our Rouge power plant Number One converts into power 75 carloads of coal per day . . . Imagine how much more an automobile would cost if we had to shovel those 75 carloads of coal by hand, shovel out the ashes, tend the fires with slicebars and old-fashioned pokers"

"What prevents everybody from being prosperous and having enough of everything is that as a nation of producers we have not yet learned how to make our products well enough and distribute them economically enough so that folks can afford to buy what they need. To accomplish universal prosperity, we must do two things. *We must make better goods less expensively. And we must pay people enough in wages so that they can afford to buy the things they make.* It is silly to talk about reducing production and raising prices as a way to prosperity. In that direction lies not prosperity but spreading poverty for everyone.

"You cannot spread prosperity by spreading the existing supply of wealth—usable goods—in a thinner and always thinner layer across all the people. We have all seen how that works out where work-sharing programs have been tried in a community or an industry. If an industry has 100,000 workers and a market for only as much goods as 75,000 full-time workers can produce, what happens when it tries to keep all these workers employed for 6 hours a day instead of employing 75,000 for the full 8 hours? Each worker averages three-quarters of a decent income, which reduces him to bare subsistence. All 100,000 workers and their families—which bring the total up to 500,000 consumers—are withdrawn from active consumption of everything except food and clothes and shelter. But if you employ your 75,000 at a good wage for 8 hours, the buying of these people will help to bring enough added employment in other industries so that pretty soon the other 25,000 will also be working at good wages and contributing their share to national prosperity.

"I do not know any magic formula for suddenly re-employing all the people who are out of work, or for starting the normal flow of production and prosperity. But I know that lower prices always start the flow. We are doing the best we know how by keeping prices down and by paying good wages and enabling our people to earn more by producing more by better methods. So are many other manufacturers, large and small. The old type of producer who thought only in profits is going out of business. When all employers in industry and business do the same set of simple things, an important step toward general prosperity will have been taken. Meanwhile the efforts of those who are proceeding along these lines are helping the general situation to mend itself. This program, not the artificial political methods advocated by people who have no experience in making both ends meet, who either do not or will not understand, is responsible for the progress that has thus far taken place.

The Factory Helps the Farm

"We cannot, of course, ignore all other classes of people in our concern for industrial prosperity. Farmers as a class are not well off today, have not been well off for ten years or more. Industry is doing more right now to solve the problem of farm surpluses and to restore rural purchasing power than any other single influence—much more than politics is doing.

"In our own business we are today using soy beans and other crops from many thousands of farm acres that formerly were contributing to a surplus of foods for the table. Research has taught us how to make a better finish for our cars from soy bean products, including soy bean oil to carry the solids in the enamel. It has shown us ways to make a dozen different parts of our car from soy bean plastics, with more important uses in prospect than we have yet attained. It has enabled us to use thousands of gallons of soy bean oil in our factory cores, replacing other oils at substantial savings, and providing a greater market for the farmer.

"Many another manufacturing business is getting similar results in finding industrial materials from farm sources. When the farm surplus problem passes into history, it will be because industry has found other uses for the acres that have for many years been producing too many foodstuffs. And in thus helping the farmer, industry is helping itself by restoring the rural purchas-

(Continued on page 73)

200 Key Men Took Motion Economy

PART TWO

★

PROF. MYRON A. LEE
Head of the Department of Industrial Engineering
Cornell University

DESCRIPTION of the course in motion economy given by International Business Machines Corporation to foremen, assistant foremen, and other key-men, begun in July (p. 248), continues with a few of the applications of motion economy principles used as illustrations in the class or developed as projects by class members.

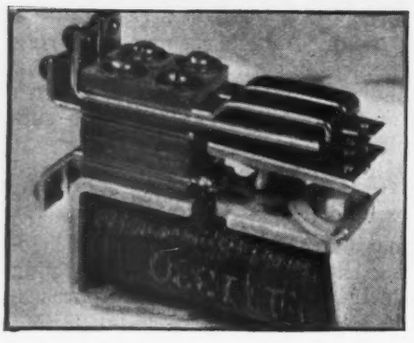
Assembly Operations

Many assembly operations were improved. A typical case was that of assembling the contacts on the relay shown in Figure 3. Originally the contacts on each side of the relay were assembled separately and held by a nut (See Figure 4). Later the nut was removed and the assembled contacts attached to the magnet yolk. The operator arranged the parts on the bench in boxes in any way that seemed convenient and assembled the parts with the right hand, holding with the left.

The new work place arrangement is shown in Figure 5.

At the center of the fixture are clips which hold four screws with heads down. On these screws two sets of contacts are assembled simultaneously, one by the left hand, one by the right. Parts are arranged conveniently in gravity feed containers and in proper sequence. After the contacts are assembled on the screws, two magnet yokes are placed in clips at the ends of the fixture. The contacts are removed from the center of the fixture and mounted on the magnet yokes. The spiral ratchet screw driver shown at the right is used for running down the screws into tapped holes in the magnet yoke. In this manner two previous operations are combined into one.

FIGURE 3



A Milling Operation

Milling the teeth in type bar rack shown in Figure 6 was originally done with the set-up shown in Figure 7. The vise was arranged with the handle toward the left of the table. This arrangement was awkward because the operator had to reach to the left of the table to open or close the vise and then back to the right end of the table to operate the hand traverse wheel. Upon making a process chart of the operation it was noticeable that the positioning of blanks and finished parts might be improved, also that the operator was performing nearly all the elements, except opening and closing the vise, with his right hand. The set-up was in accordance with usual milling practice, the cutter cutting against the feed and forcing the blank against the fixed jaw of the vise. Turning the vise around so that the handle would be at the right necessitated cutting with the feed. It was found that for this particular job there was no objection to this.

An air nozzle was arranged to blow chips out automatically when the vise was backed off. Locations of blanks and finished parts were improved, and a number of elements were performed by the left hand. The new set-up is shown in Figure 8. Note the guard which was mounted in front of the cutter. Process charts for the old and new method are shown in Figures 9 and 10. The changes resulted in a 49 per cent time saving and permitted the operator to perform the operation with equal speed and comfort either standing or sitting.

Incidentally, a short time after this improvement was made the Manufacturing Engineering Department developed a method for broaching this part. Production by this latter method is 400 parts per hour.

A third and concluding article will appear in October.—Ed.

FIGURE 4

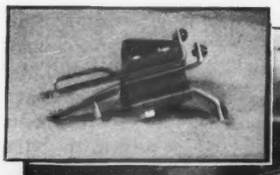


FIGURE 5

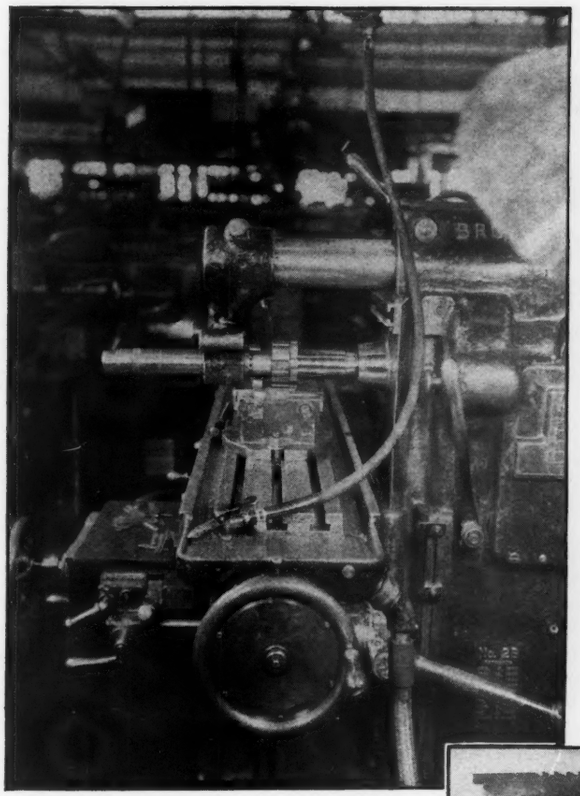


FIGURE 7

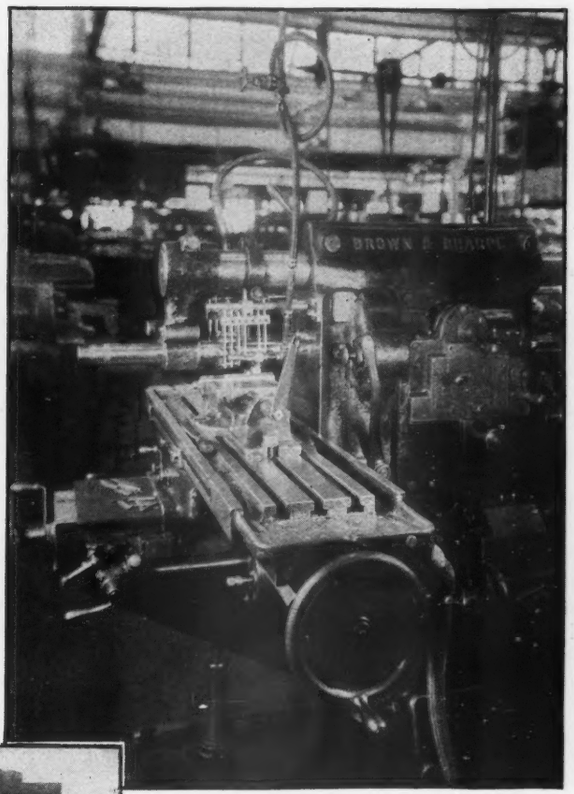


FIGURE 8

FIGURE 9

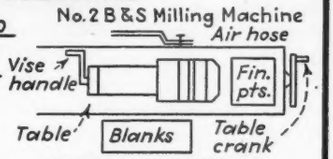
FIGURE 10

OLD METHOD

PART NO. 112044 OPER. NO. 50

DEPT. NO. 1 MACH. NO.

DESCRIPTION OF OPER. Mill teeth-type bar rack



WORK SPACE LAYOUT

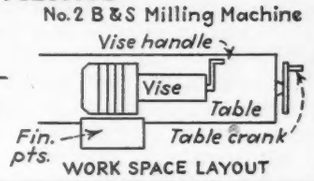
LEFT HAND	RIGHT HAND
Move to vise handle	Move to vise
Grasp vise handle	Place piece in vise
Tighten vise	Hold in position
Release vise handle	Move to table crank
Move to feed lever	Advance table to cutter
Start feed	Idle
MILL	MILL
Move to vise handle	Move to table crank
	Back off table to clear
Loosen vise	Move to vise
Idle	Remove piece from vise
	Place piece in finished parts pan
	Move to air hose
	Blow chips
Reach for blank	Release air hose
Transfer blank to right hand	Grasp blank

NEW METHOD

PART NO. 112044 OPER. NO. 50

DEPT. NO. 1 MACH. NO.

DESCRIPTION OF OPER. Mill teeth-type bar rack



WORK SPACE LAYOUT

LEFT HAND	RIGHT HAND
(Preposition part while cutting)	
Reach for vise handle	Back off table
Release vise	" " "
Reach for finished part	" " "
Slide finished part from vise	Idle
Reach for blank	"
Transport blank to vise	"
Position blank in vise	Reach for vise handle
Hold part in vise	Tighten vise
Move to feed lever	Move to table crank
Throw in feed	Advance table to cutter
MILL	MILL

For Plant Replacement — Cash

Plants will wear out. Replacement is sure as shooting. The average concern plays safer if it builds up a cash fund and holds it in the bank against the day of reckoning

H. ARNOLD STRANGMAN
Public Accountant, Los Angeles

PLANTS begin to deteriorate as soon as construction has been completed. Regardless of the efficiency with which they are maintained and kept in repair, they will eventually have to be replaced.

When that time comes, an outlay of cash, large in comparison with the size of the organization, will be necessary. Some concerns may feel that they will be able to accomplish the financing of the new plant by issue of stock or bonds, by bank loan, or by some other method; however, there is always the possibility that the method selected may not be available when the time comes.

Adequate plant facilities are of paramount importance to any organization, and the fact that the plant will not remain in serviceable condition for more than a limited number of years warrants provision for financing replacements. Replacement is not a possible contingency; it is an absolute certainty.

More Than Reserve Is Needed

Some business men believe that keeping a reserve for depreciation on the accounting records is all that is necessary. Unfortunately, however, a reserve for depreciation does not constitute a fund with which the cost of new buildings can be defrayed.

In order to make clear the functions of depreciation expense, reserve for depreciation, and other accounting classifications involved, let us take the example of a factory completed on December 21, 1920, at a cost of $60,000, whose useful life was estimated by qualified engineers to be 20 years. To write off the cost of the building over this period, the yearly "used-up value" or depreciation was reckoned at $60,000 divided by 20, or $3,000 ($250 per month). This depreciation ranked with such items as repairs, water, heat, etc., as an operating expense, regardless of the fact that it did not involve an actual outlay of cash each year.

At the end of each year, depreciation expense together with all other expense accounts was closed out into profit and loss.

Reserve Was Maintained

A reserve for depreciation of plant was maintained, its purpose being that of valuation of its related asset, the factory. An entry was made on the books each month debiting depreciation expense with $250 and crediting reserve for depreciation of plant with the same amount. A reserve for depreciation accumulates from year to year; it is not closed out at the end of each year as is depreciation expense.

It is recognized as good accounting procedure to carry buildings and plant on the books at actual cost, plus the cost of any improvements. In the preparation of a balance sheet as of a date subsequent to the acquisition of the factory, an overstatement of its valuation would result were it to be included at actual cost, for the reason that depreciation from the date of acquisition until the date of the balance sheet would not have been taken into consideration. A balance sheet as of December 31, 1925, reflected the following condition:

FIXED ASSETS

Plant account (cost)	$60,000
Less reserve for depreciation at 5 per cent per annum on $60,000 for five years, January 1, 1921, to December 31, 1925	15,000
Net valuation as of December 31, 1925	$45,000

In order to provide for financing replacement of the factory, a plant replacement fund was established, the policy being to maintain a separate bank account for this fund and to invest the cash in bonds. Average income to be earned on the principal of the fund was estimated at 3 per cent per annum.

At this time it was impossible, of course, to foretell with any degree of accuracy how much the new factory would cost 20 years later. In the absence of a more reliable basis, it was assumed that the new plant would cost the same as the original.

A contribution to the fund of $3,000 per year for 20 years would have produced the required $60,000; however, this did not take into account the income to be earned on the principal. Amount of the annual contribution was, therefore, determined as the amount of the annuity that would amount to $60,000 in 20 years at 3 per cent per annum, compounded semi-annually. Annuity tables show that an annuity of $1 will amount to $54.27 in 40 semi-annual periods at 1½ per cent per period. On this basis, $60,000 divided by $54.27, or $1,105.58, is the amount of the semi-annual contribution that will aggregate $60,000 in 20 years.

Retiring the Factory

At the end of the 20-year period, December 31, 1940, the accumulated reserve for depreciation of plant will stand at $60,000. In order to "retire" the factory on the accounting records, an entry must be made debiting reserve for depreciation of plant with $60,000 and crediting plant account (factory) with the same amount.

The plant replacement fund, in

(Continued on page 77)

This dumping truck rolls a piano over on its back

•

No helper needed to steer this one-wheel lift truck

Piano Solos

"One man, one piano" is regular handling practice at Baldwin Piano Company. The special floor trucks that make it possible are readily adaptable to use wherever similarly unwieldy objects have to be maneuvered

ARTHUR VAN VLISSINGEN, JR.
Contributing Editor

TWO SPECIAL devices for handling pianos, in use at Baldwin Piano Company, Cincinnati, may have equal utility in other plants where the product is heavy and awkward for one man to control. Each of these devices permits one man to handle a piano unassisted where, lacking the device, he would have to interrupt another man from his regular task to help out temporarily.

One of them, known in the shop as a dumping truck, is a tool for rolling an upright piano from its normal position to a horizontal position. The dumping truck is equipped with two handles, much like the commonest form of hand truck. It also has a front edge of metal, like the hand truck, for getting under the load and obtaining leverage. Major difference is that instead of coming straight up from the bottom its sides diverge. The bed on which the piano lies when the trucker takes it is as flat as on a cotton-bale truck. But the underside of the truck, coming up from the front edge, has two curved steel members, bent in an arc of about 90 degrees and looking like the very front part of an oversize pair of runners from a child's sled.

The workman comes behind the piano, puts the front edge of his dumping truck beneath it, tips the piano and catches its weight on his truck with a single motion. Now he can easily wheel the piano.

So far the operation might have been handled with an old-fashioned two-wheel truck, but when he reaches a certain section on the floor, the tip-over feature of the truck comes into play. He lowers the handles, the piano and truck rock slowly down to the horizontal position. He removes from the piano the false bottom, which with casters attached has been on the case during its trip through the factory. With this removed, the workman tilts his

(Continued on page 86)

Each Weld Like Every Other

Right equipment, right fixtures, right records — they all make quality arc welding a routine performance

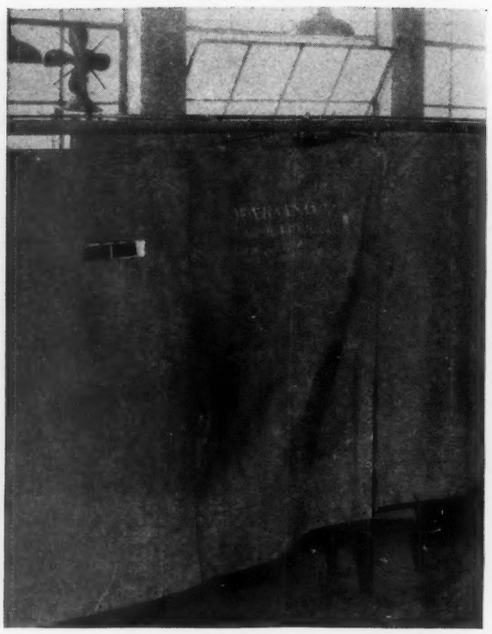
★

J. L. COCHRAN and P. F. ELDREDGE

Machinery Investigator — Foreman, Punch Press Department

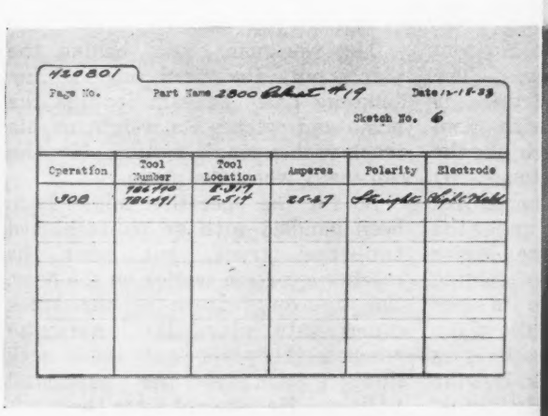
The National Cash Register Company

Dayton



First step in controlling arc welding quality was installation of a constant-potential, multiple-operator arc welding set of 250-amp. capacity.

With thin stock varying in thickness from 0.035 to 0.050 in., it was found that a good weld could not be made without a backing of copper. On corners, clamps must be faced with copper. Hence this welding fixture



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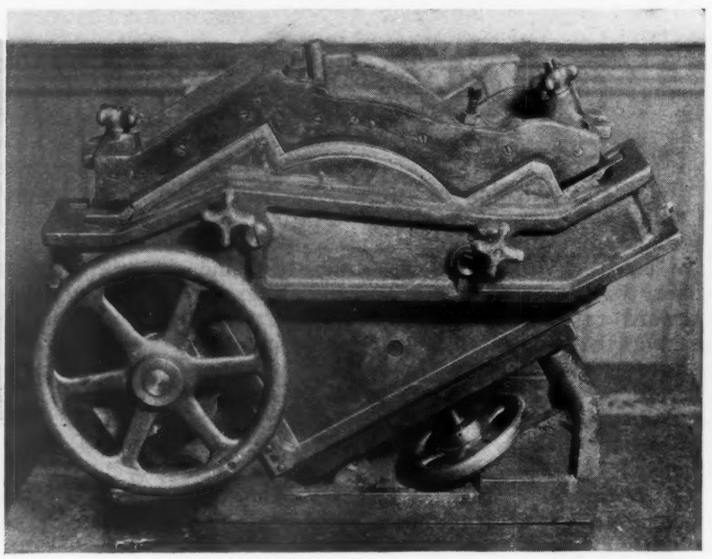
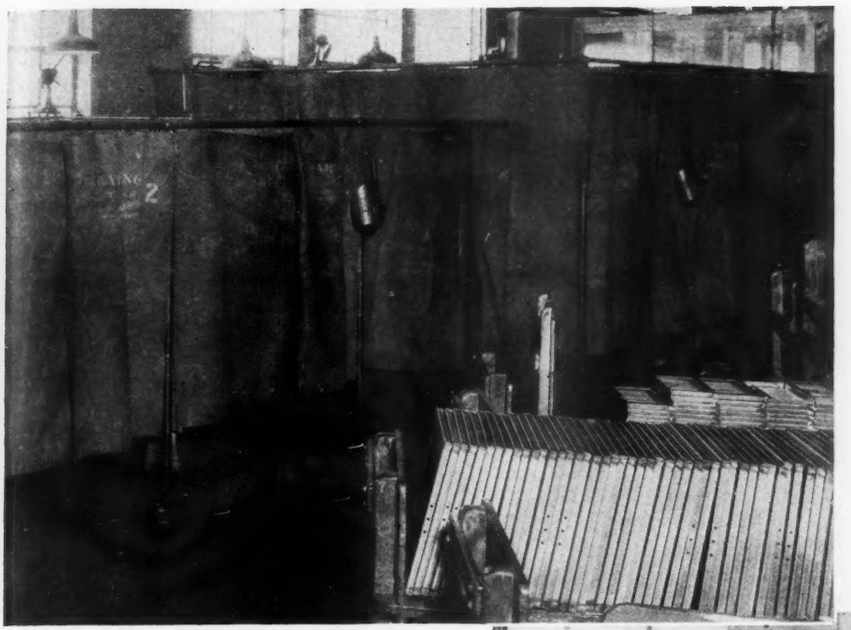
Page No. Part Name 2800 Cabinet #19 Date 12-16-38

Sketch No. 6

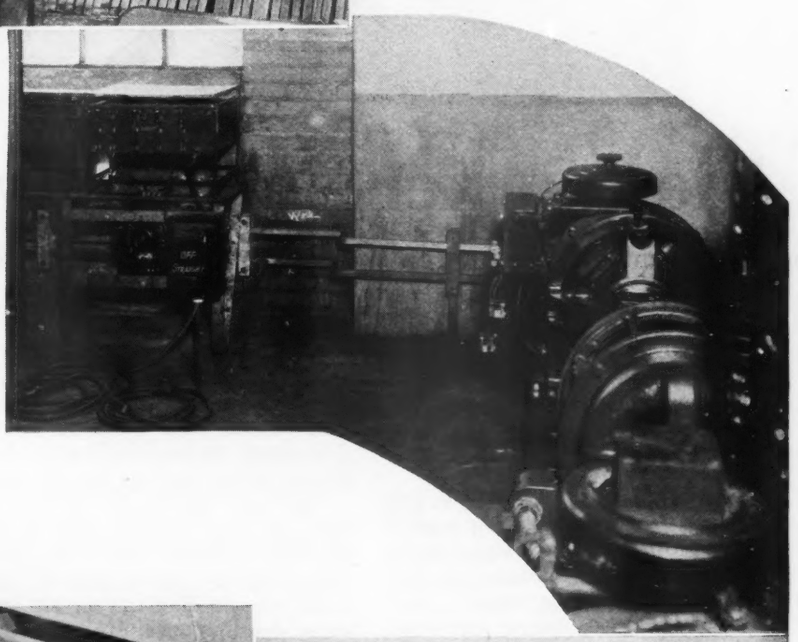
Operation	Tool Number	Tool Location	Amperes	Polarity	Electrode
308	786790 786791	F-514 F-514	25-27	Straight	Right Hand

For each welding job a record of procedure such as this is kept. Given are the number and name of part, number of sketch to be followed for location of welds. Also there is shown amperage and type of rod to use



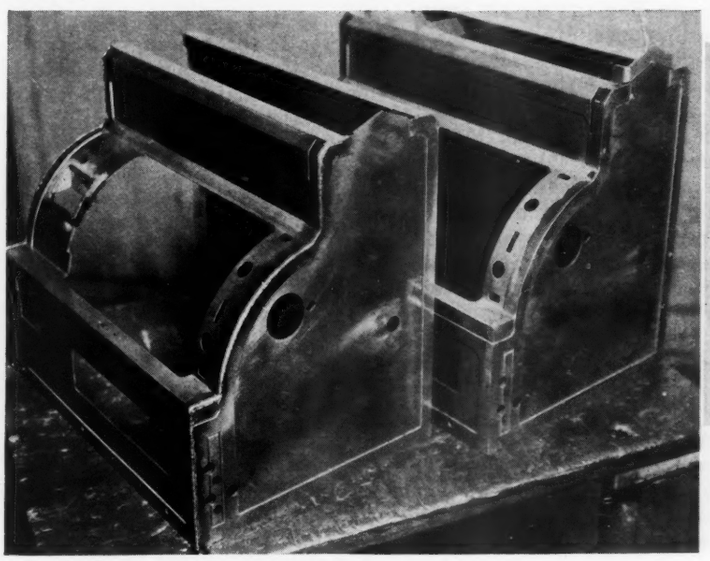


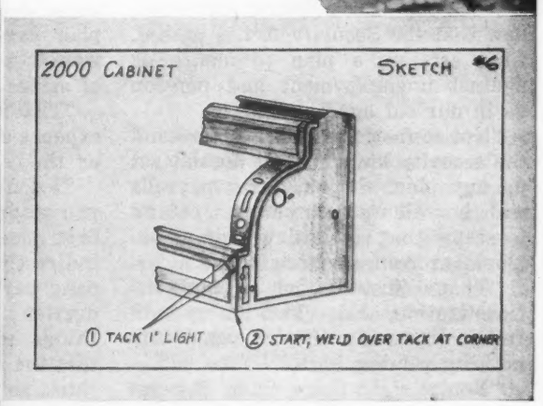
Generator voltage is set at 70, and one man is responsible for setting current. From this central generator these eight stations are operated



Inside each welding booth are a stabilizing reactor, a welding resistor, and a 10-amp. resistor for close amperage adjustment

Here's what the cabinets look like after welding. On the left—right out of the welding fixture. On the right—after grinding





Sketch cards indicating the places where arc welds are to be made, play an important part in the control of welding quality

. . . some men would rather get unemployment pay than go to work

If the worker only knew

Would he want to depend on the government for security?

BIG ED, the planer hand, was leaving the City Savings Bank when he met his co-worker, Sam.

"Still salting it away?" said Sam. "I'd think you'd know better by now."

"What's better than having a nest egg when you're old or out of work?" asked Ed. "It's a mighty comfortable feeling to know you're independent."

"It used to be, Ed. But I don't see that it makes much difference now that the Security Act is passed. That sets up a plan to insure us against unemployment and pension us in our old age."

"Not so fast, Sam. If I understand the security law at all, it doesn't set up any plan. It just taxes payrolls and then allows a 90 per cent refund to states that set up laws for unemployment compensation."

"That's just to get around the Constitution, Ed. The states will fall in line when they're taxed with nothing coming back."

"You're right there, Sam. But not all the states will have the same laws. Some of those passed already are pretty weak in spots."

"Well, I don't know about that. All I know is I think it's a darned good thing. When a man's thrown out of a job through no fault of his own he shouldn't have to depend on some hit-or-miss handout. Same's true when he gets too old to work. He should be assured against both."

"If real insurance plans were being set up, I'd agree. But most of the state schemes aren't that at all. They entirely ignore the 25 years' experience in England on job insurance. For instance, every European plan excepting Russia's makes the worker pay part of the cost. A lot of states aren't even doing that."

"That's all right with me. I've got expense enough now. I'd just as soon let the company carry the load."

"I don't believe you would, Sam, if you stopped to think it over. In the first place, you'd be paying for it indirectly anyhow. The tax the company pays increases the cost of production; you and I pay that in the things we buy. Another thing is that the tax tends to hold down wage rates, so in the long run we'll feel it on the receiving end too."

"I don't get you, Ed. If we're going to get soaked anyway, what difference does it make if we pay directly or not?"

"Simply this. There's always a lot of people who'll try to beat any system. Some men would rather get unemployment pay than go to work. And it's good workers like you, Sam, who will be paying the bill. Now if we all have to chip in a little each week we'll see that the shiftless or downright crooked don't get away with it. But if we only contribute indirectly we won't take so much interest and the costs will go 'way up."

"I see your point, Ed. You'd have the employers and employees split the cost."

"I'd go further than that, Sam. As it stands now employers will eventually be taxed six per cent on their payrolls. That's too much for a great many companies which are operating on a narrow margin. If it forces some of these out of business the unemployment problem will be worse instead of better. We're putting practically the whole load on the ones who are giving jobs. That's not right, because these things are not up to the employer alone. The workers and the general public also have part of the responsibility. I'd like to see pensions paid out of a general tax of some kind which wouldn't act as a brake on the size of the payroll."

"You've given this a lot more thought than I have, Ed. All I knew was the word 'security' and it sounded good to me. I can see it's got to be set up right."

"That's it exactly. Because if business and federal finances aren't secure there won't be any security for anybody. These so-called insurance plans run into billions of dollars, and if allowed to run wild they can do a terrific amount of damage to everybody and especially to the workers they're intended to protect. One of the greatest harms to the worker is encouraging the idea that he no longer needs to stand on his own feet—that thrift is old-fashioned and useless."

"I guess I was getting that way myself, Ed. But you're right—I don't want to have to look to the government for any part of my living. I've got a little money saved up, too, and I'm going to start adding to it each week."

•

The series to date: 30-Hour Week; Townsend Plan; Labor Relations Law; Taxes; Mechanization; Employee Representation; Profits; Security. Each available in 3x5 pamphlet form for management to distribute to workers

A course in body design attracted 119 in 1934-35, was completed by 103 employees

An Engineering School of Its Own

Chrysler selects recent graduates of accredited technical schools, gives them special two-year training in its own Institute of Engineering, turns them into research and experimental men. In addition, about a thousand people are enrolled in the Institute's evening classes

★

JOHN J. CATON

Director of Educational Research
Chrysler Corporation
Detroit

★

FOR THE past five years we have been conducting what is known as the Chrysler Institute of Engineering. It is incorporated under Michigan laws and is made up of two schools, graduate and undergraduate. The undergraduate school may issue high school diplomas; the graduate school is empowered to confer the degrees of Master and Doctor of Engineering.

Twice a year we bring outstanding engineers into the graduate school. These men are picked from recent graduates of engineering schools in this country, in Canada, and in Europe. Selection is made by our educational committee of seven engineering executives with Mr. Chrysler as chairman. It is the committee's job to separate the sheep from the goats and to be reasonably sure that the men chosen are endowed by nature to be engineers rather than doctors or lawyers or bankers or preachers.

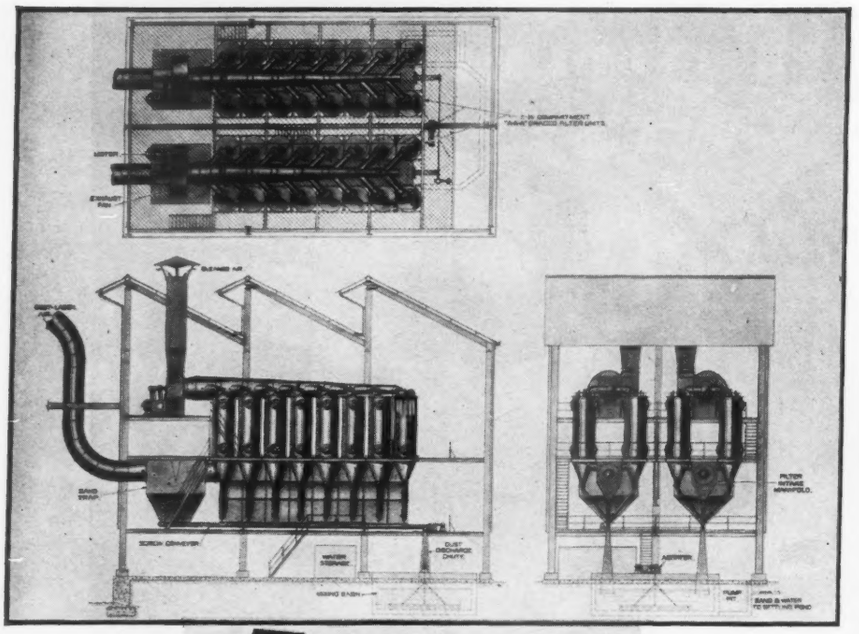
Men accepted are entered in the two-year training course. They get $125 a month the first year, $140 the second, and are moved from one department to another in the engineering division every two or four months, the time spent in each place depending upon the importance of the department.

Shop and Classroom

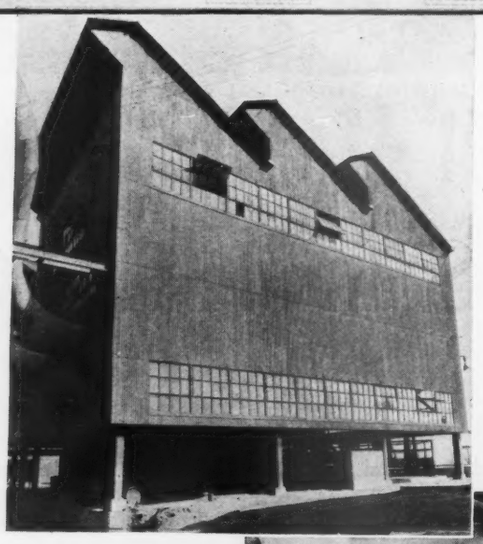
While these student engineers are in a department, they are given the same projects as a resident engineer of that department. There are no locked doors. We try to give these young men an opportunity to analyze, weigh, and study everything we do so they can carry on in a bigger and better way after we have passed on.

The practical side of the student engineer's training is paralleled by scholastic work which starts at 3:30 in the afternoon five afternoons a week. Students carry seven subjects —advanced engineering, psychology, public speaking, sociology, commer-

(Continued on page 88)



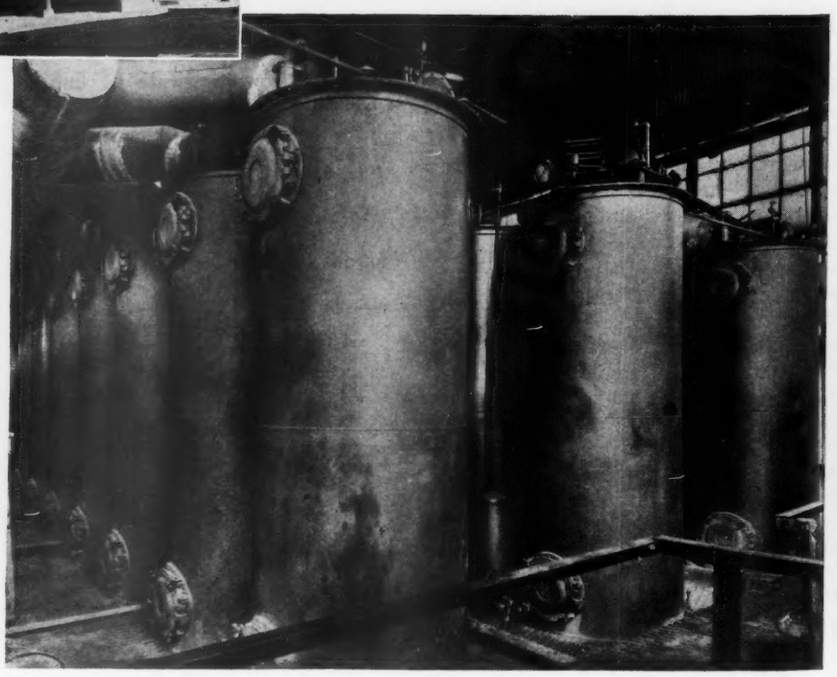
Two sixteen-compartment collecting units separate sand and dust from 60,000 cu.ft. of air per min. Dust-laden air from production building enters sand traps through 48-in. mains. Passing into intake manifolds, air rises through cloth filter bags in each compartment into exhaust manifolds on top. Exhaust fans then send cleaned air up into outer air. Collected sand and dust, moved by screw conveyors along bottom of sand traps and intake manifolds, drop through discharge chutes to mixing basin. Mixed dust, sand, and water are then pumped to settling pond a mile away



A Ton of Dust

S. D. MOXLEY
Chief Engineer
American Cast Iron Pipe Company
Birmingham, Ala.

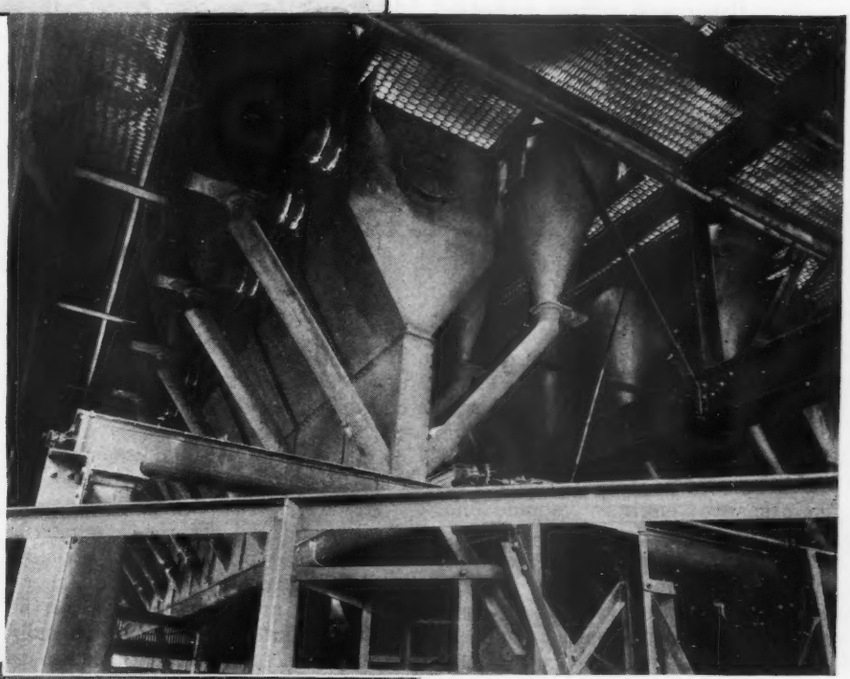
Building housing collecting units. At left, the two mains bringing dust-laden air to collectors. At right, water storage tank and dust-discharge chute running to underground mixing basin. Mechanical agitator in mixing basin keeps water moving and dust particles in suspension. Approximately one ton of dust is delivered into basin each hour; at end of each 8-hour shift, impeller sludge pumps remove sludge to settling pond dump

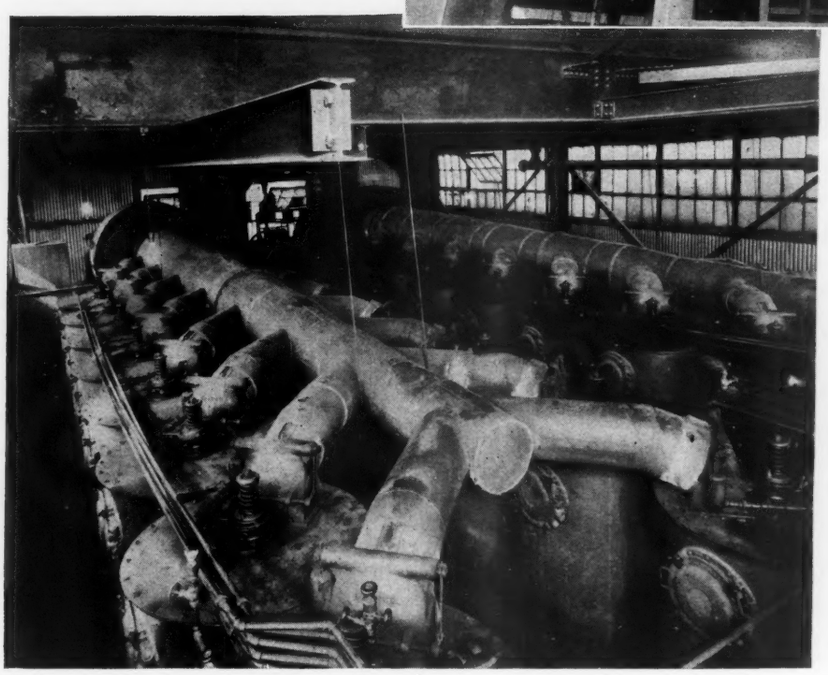


Some of the 32 filter compartments. Each contains eighteen cloth bags, ten inches in diameter and ten feet long

You can't discharge dust-laden air without causing damage to property and health in and near your plant, paving the way for ill-will, complaints, and lawsuits. Some form of cleaning equipment is imperative. This foundry installation cleans 60,000 cu. ft. of air per min., removes a ton of sand and dust each hour

an Hour





Intake manifold, hopper bottoms of filter compartments, and dust discharge pipe to screw conveyor. At left is discharge chute to mixing basin. Note dampers for closing off individual collector compartments

Exhaust manifolds leading filtered air to fans which drive air up through vents in roof. Pipes across tops of compartments are part of pneumatic shaking equipment. At intervals, filter bags are shaken, one compartment at a time, to dislodge dust. While bags in a compartment are being shaken, direction of air flow in that compartment is reversed

If Brushes Could Talk

It wouldn't be difficult for them to prove that they are often blamed for troubles whose real causes lie elsewhere

L. L. STOFFEL
Chief Engineer, The Ohio Carbon Company
Lakewood, Ohio

BRUSH TROUBLES are, strangely enough, very seldom due to causes that lie within the brush itself. On the contrary, they are much more often merely symptoms of trouble in some other part of the machine. For this reason the maintenance engineer should not hastily assume that because he can temporarily manage to stop the sparking, heating, or other trouble, everything is all right. If he does, he is likely to find out at some exceedingly inconvenient time that everything isn't all right.

A typical case of concealed trouble occurred on a d.c. multi-polar generator. Sparking had started on one set of brushes only. The commutator was cleaned with sandpaper, and the brush rocker and brush springs were adjusted until most of the sparking was suppressed. Unfortunately the maintenance man let it go at that.

Ultimately the sparking reappeared and the generator died suddenly in the middle of a working shift. Investigation showed that owing to a defect in the field rheostat the inductive discharge circuit was open. As a result, one of the field coils had short-circuited internally.

If the entire machine and its control gear had been checked up in the first place, the shutdown would not have happened.

Another instance concerned an a.c. motor driving a fuel oil pump for an annealing furnace. The starter was of the usual radial, hand-operated type. Both motor and starter had been removed from another part of the plant where the motor had been driving an approximately equal load consisting of a group of drill presses.

After it had been installed and direct-connected to the pump, the motor developed sparking trouble while starting up, especially while the starter arm was passing over the first few contacts, although it usually ran satisfactorily when once up to speed. The brushes were re-bedded accurately, and the spring pressure was increased. These measures got rid of some of the trouble, but commutation at starting was more or less unsatisfactory for two or three months.

The following winter the sparking again increased, although when the motor was tested its running load did not seem to be excessive.

Being of an inquiring mind, the maintenance man did some investigating and discovered that, although the fuel oil tank was warmed by steam coils in cold weather to assure proper flow through the feed pipe, there was a small section of the line that was somewhat exposed to the weather. The partly congealed oil in this section greatly increased the starting load, although as soon as the warmer oil commenced to flow from the tank this excessive drag on the motor was relieved.

Moreover, since the starter was designed for normal starting conditions its resistance was too high for handling the initial power demand, thus causing surges of current which produced sparking at each contact, as well as on the motor brushes.

Burying the pipe section deeper in the ground and changing the starter solved the problem quite satisfactorily.

Motor Sluggish at Start

Here is another case of trouble that would not have happened with adequate inspection. The a.c. slip-ring motor on a crane bridge started sluggishly and apparently labored a good deal under load. Inspection showed that two of the rotor slip-

(Continued on page 78)

. . . what the plant manager said when the shutdown occurred was highly decorative

Motors Tell Tales

Frequent operation of protective devices led, in this plant, to a study of motor loads, which showed how power bills could be cut $1,300 a year

K. S. SMILEY
Plant Engineer, Kendall Mills
New Bedford, Mass.

EVERYONE finds out sooner or later that trouble with motors and other electrical equipment frequently is due to abnormal conditions or defects in the driven machinery. Realization of that fact will often make it possible to save time in locating the real cause of trouble. At least that is the way it worked out in our case.

We have an installation of 801 40-in. Model K, Draper looms that are individually driven by ½-hp., 220-volt, three-phase motors. These motors are controlled and protected against overload by manually operated starters of the thermal overload type.

The full-load ampere rating of these loom motors is 1.49 amp. According to the manufacturer, motors with full-load ratings of 1.32 to 1.58 amp. should be protected with 1.8-amp. thermal cutouts. On these loom motors, 1.8-amp. cutouts would permit 21 per cent overload. Past experience has shown that this does not allow enough leeway. Therefore the thermal cutouts in this installation are of 2.1-amp. rating, which of course allows a 41 per cent overload before the device functions. We have found that this leeway is ample for operating purposes and at the same time provides sufficient protection against burnouts.

When a thermal overload cutout operates, one or more of the following conditions exist:

1. The motor is overloaded.
2. There is mechanical trouble in the cutout itself, such as a poor contact at the fusible link, or the wire to, in, or from the heater coil of one of the cutouts has been broken off.
3. The motor has stalled for some reason.
4. A branch circuit fuse has blown.

During the first nine months that these looms were operated we encountered considerable trouble with the thermal cutouts at various looms opening repeatedly. As is usual under such circumstances a number of different schemes were tried to overcome what was considered to be mechanical or electrical trouble in the cutouts themselves. Eventually it became obvious that the trouble was not due to faults in the cutouts, but rather to improper mechanical adjustment of the looms, with the result that the motors were overloaded and the cutouts were functioning just as they were designed to do.

About this time we obtained a clip-on type of ammeter with 0 to 50 and 0 to 200 scales and rigged it up for making tests of the amount of power required by the looms.

Such an ammeter indicates the current flowing through any conductor inclosed by the tongs of the instrument. The reading obtained is a direct multiple of the number of

TABLE I—Results of First Tests on Loom Motors

Loom No.	Construction	Reading	Amperes	Per Cent Overload
337	20 x 16	38	1.90	28
448	18 x 14	29	1.45	0
444	18 x 14	32	1.60	7
465	18 x 14	37	1.85	24
427	28 x 24	32	1.60	7
380	32 x 28	33	1.65	11
406	44 x 40	33	1.65	11
417	44 x 40	35	1.75	18
Average	.....	..	1.68	13.2

turns of the conductor inclosed. That is, if a conductor is carrying 5 amp. and one turn is inclosed by the tongs, the meter will register 5 amp. If a loop is made in the conductor so that the tongs inclose two turns, the meter will register 10 amp., and so on.

We made up a coil containing twenty turns of No. 14 flexible wire and fitted each end with a rubber-covered test clip. Such a coil, when carrying 1.49 amp., say, will cause the meter to indicate 20 × 1.49 = 29.8 amp., which is close to the midpoint of the 0-50 scale of the meter.

We found that it is an easy matter to remove one of the thermal links in a loom motor starter, and clip one end of this 20-turn coil to the center post and the other to the spring element. We start the motor and then the loom, clip the tester over the coil, and observe the readings. The first day that this outfit was assembled one or more motors in several loom fixer's sections were tested. The results, shown in Table I, were highly illuminating.

One of the immediate results of taking these data was a sudden and nearly 100 per cent decrease in the number of repair orders covering thermal cutout trouble on the loom motors. This situation came about because the weave room overseer made it a rule that before such a repair order was issued, the loom in question must be carefully checked either by him or the second hand so that any necessary adjustments could be made and the load on the motor thereby decreased.

What Does the Tester Say?

Upon receipt of a repair order covering thermal cutout trouble, the electrician arms himself with the tester and goes to the loom in question. He has been instructed to: (1) Check for mechanical trouble in the cutout; (2) take a reading of the current drawn by the motor while it is in operation; (3) report his findings to the second hand or overseer of weaving.

The loom fixers have gradually come to realize that these power tests are really significant, and they are right on deck when the electrician goes to a loom. While the electrician takes power readings, the loom fixer makes various adjustments on the loom until the power required has dropped to the normal figure.

So far we have found that the chief source of overload usually is improper adjustment of the friction clutch.

About 95 per cent of the few repair orders now received cover looms whose motors are found to be drawing 1.9 to 2.0 amp. In none of these cases has the trouble from opening of thermal cutouts disappeared until the loom has been adjusted so that the current reading drops to 1.6-1.7 amp. There have been some hot arguments, to be sure, but the meter has always come out ahead.

Less Power, Fewer Stoppages

The other 5 per cent of the repair orders for this class of work cover mechanical trouble in the starters or cutouts themselves.

Important as this improvement is, the most significant returns from this work are shown in the records in Table II, power consumed by the weave room.

It will be noted that previous to the week of 9/14, the average power input to the weave room was about 357 kw. and the power taken per loom was 0.467 kw. Measurement of power consumption was started the next week. Since then the power input has dropped to an average of 341 kw. and the power per loom to 0.441 kw. We are convinced that most, if not all, of this improvement can be attributed to the use of the tester, which has led to more careful adjustment of the looms.

TABLE II—Power Consumption in Weave Room

Week Ending	Kilowatts BEFORE TESTER WAS USED	Kilowatts per Loom
8/17.....	349	0.467
8/24.....	363	0.473
8/31.....	359	0.476
9/7.....	354	0.450
9/14.....	359	0.471
Average....	356.8	0.467
AFTER TESTER WAS USED		
9/21.....	345	0.444
9/28.....	336	0.441
10/5.....	336	0.439
10/12.....	346	0.455
10/19.....	346	0.457
10/26.....	333	0.434
11/2.....	342	0.432
11/9.....	343	0.439
11/16.....	341	0.440
11/23.....	345	0.438
11/30.....	339	0.433
12/7.....	340	0.436
12/14.....	344	0.441
Average.....	341.2	0.441

We have set up a routine checking system whereby each week the weave room overseer makes up and sends to the repair shop a list of 20 or 25 looms, with the request that power readings be taken on them. This list covers a few looms in each loom fixer's sections, and embraces different looms each week. The overseer takes the report and checks with the loom fixer on looms that are taking an abnormal amount of power.

On the basis of these data there has been a power saving of 16 kw., which means 1,280 kw.-hr. a week. With 80 hours' operation and an energy cost of 2 cents the saving is $25.60 a week. The tester saved its cost in a little over three weeks. Marked decrease in the number of loom stoppages due to operation of the thermal cutouts has also resulted in a saving, although the amount is difficult to measure.

•

"Smokos" for Factory Girls

J. C. GRAHAM
Auckland, New Zealand

GIRL employees in a leading millinery factory in Auckland, New Zealand, are being encouraged to smoke a cigarette during two breaks, morning and afternoon. These breaks, called "smokos" in New Zealand, are usual in many industries for men, but only tea-drinking has been tried before for girls. Directors were surprised to find that 80 per cent of the girls smoked the first morning.

The experiment has proved a great success. Smokos have a soothing effect on nerves, reduce headaches, and increase production. Smoke is quickly cleared away by a modern air-conditioning plant.

This same factory has also experimented with radio music in its workrooms, and has found that four half-hour periods daily are most satisfactory. The music is not helpful to many of the girls over longer periods, and becomes definitely trying to some if kept on all day.

Ground Portable Equipment Too

D. STOETZEL
Industrial Engineering Department
General Electric Company
Schenectady, N. Y.

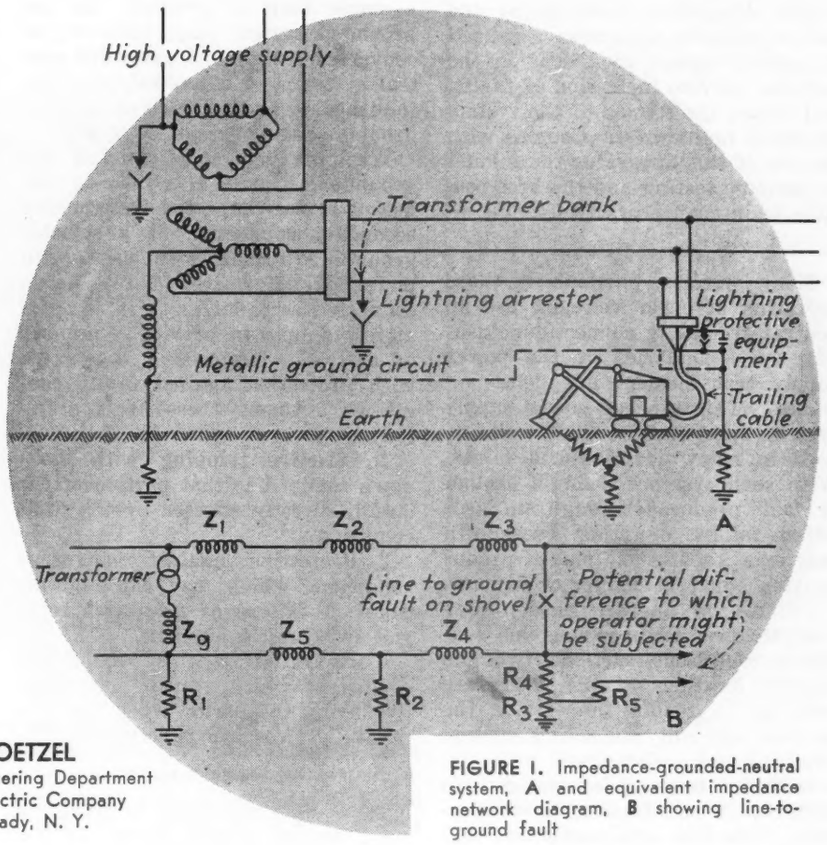


FIGURE 1. Impedance-grounded-neutral system, A and equivalent impedance network diagram, B showing line-to-ground fault

Z_1 Effective impedance of supply system and transformer

Z_2 Effective impedance of overhead distribution line

Z_3 Effective impedance of trailing cable

Z_4 Effective impedance of ground-return conductor in trailing cable

Z_5 Effective impedance of metallic ground-return circuit from trailing cable to substation ground terminal

Z_6 Effective impendance of ground-current limiting device at substation

R_1 Grounding resistance at substation

R_2 Resistance of grounding terminal at pole-line end of trailing cable

R_3 Earth resistance between junction of R_4 and R_5 to mean earth potential

R_4 Resistance between shovel treads and earth

R_5 Resistance between operator and earth

An impedance-grounded-neutral system gives good protection from shock hazards, permits selective tripping on line-to-ground faults

PERMANENT installations of electrical equipment can be effectively grounded without much difficulty, thus minimizing the danger of shock. There is, however, a good deal of equipment in use that is portable, or not permanently installed. In such cases the problem of grounding is more complicated, with the result that it is less likely to be done properly, so that the danger to operators and workmen is increased.

For example, self-propelled, electrically driven machines of several kinds are used in various industrial operations, such as cement mills, open pit and underground mines, rock quarries, and steel mills. Power is supplied through rubber-covered trailing cables. Many of these machines, such as shovels and other excavating equipment, have caterpillar traction and are moved frequently during regular operation.

Other equipment, such as large drill rigs, skidded substations, construction equipment, and pumps, as well as certain large machine tools, presses, and rolls, may be located on semi-permanent foundations and moved only occasionally.

With self-propelled machines that use electric current at relatively high operating voltages, dangerous conditions are especially likely to exist. On machines that are installed in a semi-permanent manner and operate on a lower voltage, these conditions may still exist, although the possibilities of trouble are somewhat reduced and the danger may be less serious.

On a.c. circuits the element of danger usually exists because of the difficulty of securing a good, low-resistance ground at the machine itself and at the neutral point of the transformer supplying power for the operation.

In addition, there is the possibility of a path or circuit of relatively high impedance existing between the machine frame and the transformer neutral point, with a relatively high potential difference between points that are closely spaced physically along the ground, but separated by rather high electrical resistances.

Dangerous conditions may be prac-

tically eliminated, however, by the use of suitable apparatus arranged to control voltage conditions in the circuits, provide indication of faults, and isolate the section of the system on which faults exist. Coupled with the use of this apparatus there must be periodic testing and the best possible maintenance practice.

Ungrounded System

Many systems, particularly those operating at lower voltages, use no neutral grounding connections; usually the secondaries of the power supply transformers are delta-connected. This type of power supply system operating at 2300 volts is used in many quarries and mines. With such systems a single ground or fault produced through an insulation failure or other breakdown may exist on any one phase without causing apparent danger or damage.

Failure on another phase, however, then results in serious and dangerous conditions, particularly if the relative locations of the faults are such as to render inoperative the devices normally protecting against overload and undervoltage.

With the ungrounded system it is difficult, if not impossible, to provide protective equipment that will indicate the location of the fault and at the same time confine protective shutdown action to that portion of the distribution system which is actually affected. For a very simple system involving only one circuit, say from transformers to a single power shovel, the ungrounded system may work out satisfactorily.

On the usual type of system, feeding a number of machines and involving numerous branch circuits, selective tripping and individual circuit protection are highly desirable in order to eliminate a shutdown of all the machines in the event of a single fault or ground. An ungrounded system may, however, be converted readily to a grounded neutral system and a neutral point established by the addition of suitable grounding transformer equipment.

With the neutral established and grounded, Figure 1, either by the use of a star-connected transformer secondary connection or a suitable grounding transformer used with power transformers having delta-connected secondaries, it is comparatively simple to provide a number of desirable features in connection with protection against faulty conditions. Among these are the following:

1. Selective tripping with shutdown confined to that portion of the circuit directly affected by the fault condition.

2. Protection against dangerous conditions which may exist on account of failure of protective relay and switching equipment.

3. Protection against dangerous conditions which prevail momentarily during the period when the protective devices are functioning.

Low Impedance Return Circuit

It becomes necessary to provide a solid ground return circuit of low impedance from the machine frame back to the transformer substation, with a sufficient number of intermediate, well-earthed ground connection points. In order to minimize the possibility that high-voltage disturbances on the primary side of the transformers may carry over and create dangerous conditions on the low-tension side, it is advisable that the earthing electrode nearest the transformer Y point be located outside the transformer substation and at some little distance from it.

If the ground return conductor is carried directly back to the transformer neutral, any short circuit or low-resistance fault to ground permits the flow of a very high current in the neutral conductor. Flow of such a large amount of current causes voltage gradients of formidable proportions across even relatively low impedances. Such voltage conditions may prove dangerous at unexpected points in the system.

High Impedance at Substation

To correct the condition discussed in the preceding paragraph, there should be provided at the transformer substation a relatively high impedance through which the incoming ground circuit is connected to the neutral point of the main or grounding transformers. In some cases the necessary impedance will be inherent in the design of the grounding transformers.

In any event, the effect will be the same as the use of a grounding impedance in connection with star-connected transformers. This circumstance makes it possible to control the flow of ground current under short-circuit conditions and limit it to a value such that the resultant voltage gradient at any point or at adjacent points along the ground return path will not be dangerous.

It will also result in the concentration of a large percentage of the ground-return-circuit potential gradient across the grounding impedance which, therefore, should be well insulated and arranged to afford protection against accidental contact.

With this scheme it will be advisable to use carefully designed protective relay and oil circuit breaker equipment to meet individual conditions and to isolate the circuits affected by the ground fault condition without interrupting operation on other branches of the system. This limited-ground-return arrangement is similar in some respects to an ungrounded neutral system. However, a definite amount of ground current is permitted to flow when a line-to-ground fault occurs and protection is provided against the possibility of excessive voltages due to an arcing ground.

The effectiveness of the system, so far as mitigating danger is concerned, is lost if two line-to-ground faults occur on different phases at the same time, as in Figure 2. This condition becomes in effect a line-to-line short circuit, possibly involving a section of the ground return circuit, and the short-circuit current is limited only by the normal power circuit impedances. This means that

(Continued on page 90)

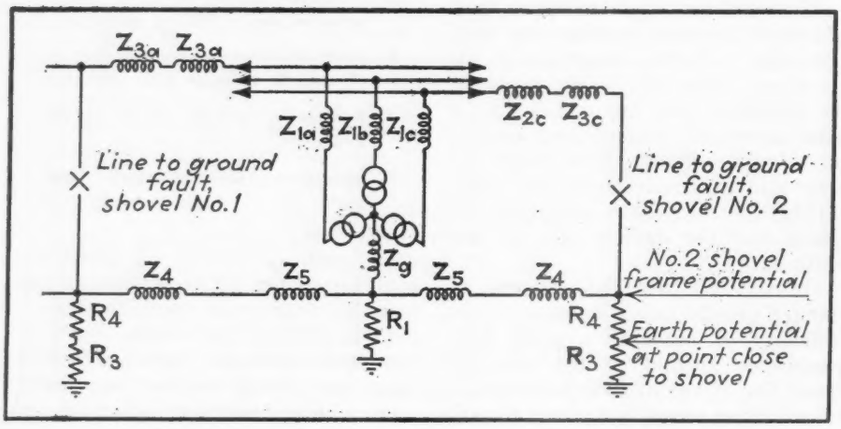

Z_{3a} Z_{3a}
Z_{2c} Z_{3c}
Z_{1a} Z_{1b} Z_{1c}
Line to ground fault, shovel No.1
Line to ground fault, shovel No. 2
Z_4 Z_5 Z_g Z_5 Z_4
No.2 shovel frame potential
R_4 R_3 R_1 R_4 R_3
Earth potential at point close to shovel

FIGURE 2. Equivalent impedance network diagram of the system shown in Figure 1, with two simultaneous ground faults

A.C. Wave Windings

Connecting diagrams and tables for windings having five slots per pole per phase

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IN A previous article, May issue, connecting diagrams and tables were given for windings having 4½ slots per pole per phase. In this article the connecting diagram, Figure 7, Connecting Table VII, and Checking Chart VII for five slots per pole per phase are presented. In addition, the procedure will be given for winding an armature with coils of the special short-lead type, using right- and left-hand phase coils with both odd and even coil grouping.

Let us first consider a three-phase, 10-pole, 150-slot winding that has 5 slots per pole per phase, which gives even grouping with 4 conductors per slot. Assume that the conductors are of such size that special short-pitch, short-lead coils must be used.

For a 10-pole, three-phase winding there will be 3x2x10 = 60 phase coils. Therefore, for more than two conductors per slot there will be required 30 right-hand and 30 left-hand phase coils. From Connecting Table VII and the connecting diagram, Figure 7, it will be found that there are four short-pitch connections at six places in the winding; namely, *SP1, SP2, SP3, SP4, SP5, SP6*. It is also customary to make the *1, 3, 4* and star leads of each phase a short lead.

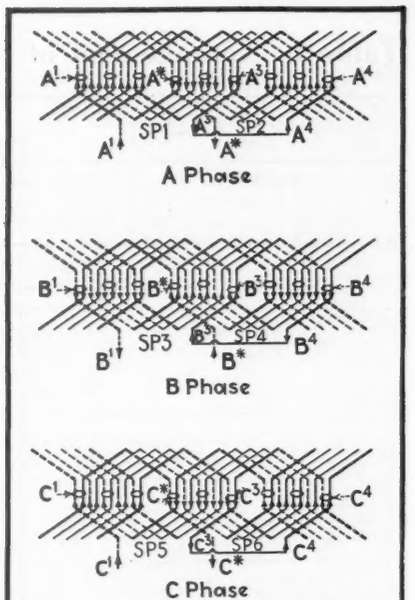


FIGURE 7. Connecting diagrams for a.c. wave windings having five slots per pole per phase. These diagrams are to be used with Connecting Table VII

From the foregoing it is evident that each phase will have 10 top short-lead coils and 10 bottom short-lead coils, or there will be a total of 60 short-lead coils. Also each phase will need:

Two right-hand short-top-lead phase coils

Two left-hand short-top-lead phase coils

Two right-hand short-bottom-lead phase coils

Two left-hand short-bottom-lead phase coils

The coils in this 10-pole, 150-slot winding will be divided into three major groupings, or nine different piles, as follows:

Group 1. 90 full-pitch coils, consisting of
- 18 right-hand phase coils
- 18 left-hand phase coils
- 54 plain coils

Group 2. 36 short-lead plain coils, consisting of
- 18 top-lead, short-pitch coils
- 18 bottom-lead, short-pitch coils

Group 3. 24 short-pitch phase coils, consisting of
- 6 top-lead, short-pitch, right-hand phase coils
- 6 top-lead, short-pitch, left-hand phase coils

Checking Chart VII. 5 Slots per Pole per Phase

No. of Slots	No. of Poles	Polarity	Phases C					B					A				
		↑	11	10	9	8	7	6	5	4	3	2	1	Z	Y	X	W
		↓	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12
60	4	↑	41	40	39	38	37	36	35	34	33	32	31	30	29	28	27
		↓	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42
90	6	↑	71	70	69	68	67	66	65	64	63	62	61	60	59	58	57
		↓	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72
120	8	↑	101	100	99	98	97	96	95	94	93	92	91	90	89	88	87
		↓	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102
150	10	↑	131	130	129	128	127	126	125	124	123	122	121	120	119	118	117
		↓	146	145	144	143	142	141	140	139	138	137	136	135	134	133	132
180	12	↑	161	160	159	158	157	156	155	154	153	152	151	150	149	148	147
		↓	176	175	174	173	172	171	170	169	168	167	166	165	164	163	162
210	14	↑	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177
		↓	206	205	204	203	202	201	200	199	198	197	196	195	194	193	192
240	16	↑	221	220	219	218	217	216	215	214	213	212	211	210	209	208	207
		↓	236	235	234	233	232	231	230	229	228	227	226	225	224	223	222
270	18	↑	251	250	249	248	247	246	245	244	243	242	241	240	239	238	237
		↓	266	265	264	263	262	261	260	259	258	257	256	255	254	253	252
300	20	↑	281	280	279	278	277	276	275	274	273	272	271	270	269	268	267
		↓	296	295	294	293	292	291	290	289	288	287	286	285	284	283	282
330	22	↑	311	310	309	308	307	306	305	304	303	302	301	300	299	298	297
		↓	326	325	324	323	322	321	320	319	318	317	316	315	314	313	312
360	24	↑	341	340	339	338	337	336	335	334	333	332	331	330	329	328	327
		↓	356	355	354	353	352	351	350	349	348	347	346	345	344	343	342

Table I. Arrangement of Coils in 3 Groups and 9 Piles

Group No.	Type of Group	Symbol	Type of Coil	Method of Calculating
1	Full-Pitch Coils	*C*	R.-h. phase coils	(*P*×3)—12
		D	L.-h. phase coils	(*P*×3)—12
		E	Plain coils	*B*—(*F*+*G*)
2	Short-Lead Plain Coils	*F*	Top-lead coils	(*L*—*1*+*M*—1)×3
		G	Bottom-lead coils	(*L*—1+*M*—1)×3
3	Short-Lead Phase Coils	*H*	Top-lead, r.-h. phase coils	Always 6 coils
		I	Top-lead, l.-h. phase coils	Always 6 coils
		J	Bottom-lead, r.-h. phase coils	Always 6 coils
		K	Bottom-lead, l.-h. phase coils	Always 6 coils

A = *P*×6 = Total number of phase coils
B = *N*—*A* = Total number of plain coils
P = Number of poles
N = Total number of slots
L = One less than the number of short-pitch connections at *SP1–3–5*
M = One less than the number of short-pitch connections at *SP2–4–6*
R.h. = Right hand
L.h. = Left hand

6 bottom-lead, short-pitch, right-hand phase coils
6 bottom-lead, short-pitch, left-hand phase coils.

Before starting to wind the armature, the coils should be sorted into the nine groups described above and in Table I, which provides the data for figuring the number of coils in each group or pile, for any winding in this series.

The best method of inserting windings of this type is to arrange the coils in nine piles. On the core select slot *1* in the proper relation to the slipring connection, and mark this slot with chalk for the full width of the core. This mark will identify the starting point of the winding and the *A1* lead coil, which is a left-hand short-bottom-lead phase coil.

Next, mark on the core with chalk the location of the slots that contain the short-bottom-lead coils. Mark these slots at the front or collector-ring end of the core. The proper connecting diagram and table for each winding, in this case Figure 7 and Connecting Table VII, must be used for marking the core.

Referring to Figure 7, the front of slots *1, 150, 149, 148,* and *147* would be marked to locate the first group of short-bottom-lead coils. The next group of short-bottom-lead coils is located at *SP2* or ahead of the *A** slot. Connecting Table VII shows that the *A** lead is in slot *136*; the other slots are *135, 134, 133,* and *132.*

The next group of short-bottom-lead coils is at *SP3,* or ahead of the *B1* slot, and lies in slots *51, 50, 49, 48,* and *47.* Likewise the fourth group, *SP4,* lies in slots that are ahead of the *B** lead, or slots *36, 35, 34, 33,* and *32.*

Now the short-bottom-lead coils of the *C* phase are marked at *SP5* and *SP6,* which are ahead of the slots containing the *C1* and *C** leads, or slots *101, 100, 99, 98, 97,* and slots *86, 85, 84, 83,* and *82.* The six groups of short-bottom-lead coils have now been located and marked.

The next step is to locate and mark the slots that contain the short-top-lead coils; these markings should be placed at the rear end of the core and should indicate the slots in which the bottom half of the short-top-lead coils are wound. This is done so that the winder picks up the marked slots, front and rear, as each coil is wound in. The bottom coil half of every coil is started first in the bottom of a slot.

To mark the short-top-lead-coil slots, refer to Figure 7 and Connecting Table VII. Start at *SP1,* which in this case shows the slots starting at the *A3* lead and to the left of the lead. To mark the bottom slots of these coils, subtract from the *A3* slot, *132,* the back pitch. With this armature it will be *132* — *15* = slot *117.* Then mark slots *121, 120, 119, 118,* and *117.* At points *SP2, SP3, SP4, SP5, SP6* do the same thing; that is, locate the *A4, B3, B4, C3,* and *C4* slot numbers, subtract the back pitch in slots, and mark this slot and the four to the left of it.

With 60 slots marked at the front and rear ends of the core, the coils are started in slot *1* with a short-bottom-lead, left-hand phase coil. Then progress around the core counter-clockwise putting in three short-bottom-lead plain coils in slots *150, 149,* and *148.* Slot *147* receives a short-bottom-lead, right-hand phase coil.

From slot *147* to the slot at the left of the next marked slot, both right- and left-hand, full-pitch coils are used, with plain coils filling out the groups.

Close attention must be given to the slot markings as well as to the proper coil to be placed in the various slots.

In the next article, which will appear in an early issue, the matter of odd grouping will be discussed. The connecting diagram and tables for 5½ slots per pole per phase will also be given.

Connecting Table VII.* 5 Slots per Pole per Phase

		A Phase				B Phase				C Phase				Short Pitch Connections	
No. of Poles	No. of Slots	Bottom Leads A1		Top Leads A3	A4	Bottom Leads B1		Top Leads B3	B4	Bottom Leads C1		Top Leads C3	C4	SP 1–3–5	SP 2–4–6
4	60	↑ 1	46	42	27	↓ 21	6	2	47	↑ 41	26	22	7	4	4
6	90	↑ 1	76	72	57	↓ 21	6	2	77	↑ 71	56	52	37	4	4
8	120	↑ 1	106	102	87	↓ 81	66	62	47	↑ 41	26	22	7	4	4
10	150	↑ 1	136	132	117	↓ 51	36	32	17	↑ 101	86	82	67	4	4
12	180	↑ 1	166	162	147	↓ 141	126	122	107	↑ 71	56	52	37	4	4
14	210	↑ 1	196	192	177	↓ 141	126	122	107	↑ 71	56	52	37	4	4
16	240	↑ 1	226	222	207	↓ 81	66	62	47	↑ 161	146	142	127	4	4
18	270	↑ 1	256	252	237	↓ 111	96	92	77	↑ 191	176	172	157	4	4
20	300	↑ 1	286	282	267	↓ 201	186	182	167	↑ 101	86	82	67	4	4
22	330	↑ 1	316	312	297	↓ 111	96	92	77	↑ 221	206	202	187	4	4
24	360	↑ 1	346	342	327	↓ 261	246	242	227	↑ 131	116	112	97	4	4

* See Figure 7 for connecting layout. Front and back pitches = 1 and 16. Short pitch (SP) = 1 and 15.

You want to know

and the editors will gladly tell you more about the things mentioned on this page

• PLUG FUSES, usable over and over again, make their bow. Great expansion characteristic of mercury is the secret. When overload generates heat, expands mercury, and breaks circuit, you simply unscrew fuse, shake the mercury back into place. (9601)

• PAINT CLEANER, claimed to restore original luster of paint by removing dust film collected on painted surfaces. Mix with water and wipe down surface with soaked sponge. (9602)

• SILICOSIS continues to loom as a serious industrial problem. There's a booklet reprint of an article on its medico-legal aspects. (9603)

• RUSTPROOFING process which prevents corrosion and holds paint on zinc die castings and galvanized iron, both coats and alters the surface of the metal. It comes in concentrated liquid form for addition to water to make working solution. (9604)

• FLASHLIGHT, with no external moving parts or switches, is sealed and gasketed against entrance of water, gases, or vapors. It's operated by a "fly casting" flick of the wrist, and you can use it in hazardous locations or submerge it in water. (9605)

• ALUMINUM PAINT, being used more and more, and on a variety of surfaces, is something to know more about. There's a free booklet on its uses and application. (9606)

• ACCIDENT experience in the sheet metal industry is subject of a report assembled from 179 plants. Both statistical and explanatory, it goes into causes and nature of the accidents. (9607)

• PRIZE for novelty and utility goes this month to a flashlight screwdriver for use in dark places. It combines a light weight screwdriver and flashlight in one tool. (9608)

• METAL POLISHING is subject of a booklet which discusses essential factors of glue, abrasive, setting-up, and operation. And there's a companion volume on grinding and finishing with portable equipment. (9609)

• CORROSION of ferrous metals can be combated by a process that drives silicon into the material. Castings, forgings, and machine parts can be made acid resistant with a surface so hard that it resists a hacksaw. (9610)

• WATERPROOFING problems? Try a new colorless, transparent liquid applied by spraying or brushing. Said not to weather, crumble or crack, and to be effective on wood, brick, concrete, etc. A paint coat can be applied over it. (9611)

• EMULSIFYING base, soluble in water, glycerine, glycols, and 50 per cent alcohol, but immiscible with organic solvent, is non-hygroscopic at ordinary humidities, non-volatile up to 100 deg. C. (9612)

• IF YOU WANT to flush out motor cooling systems, a new flushing gun employing both air and water pressure is recommended. Force of the blast is increased by a special fitting, and there is trigger control of the air. (9613)

• OILER can deliver 1/10 drop of oil at a time. It's fountain pen size, made of brass with Pyralin insert to make contents visible. (9614)

• FOR the factory yard and roads—a surfacing material in powder or liquid form. Easy to apply and ready for use immediately after laying. (9615)

• TITLE of a free report is "The Physical Inventory Procedure of an Industrial Plant." Covers organization and preparation for inventory taking, enumeration and listing of inventories, figuring and computing inventory. (9616)

REMOVING INK and typewriting from paper and polishing small metal pieces is all the same to this eraser, made of spun glass fibers. The holder is fountain pen like, and the erasing element is renewable (9624)

CORN is only one of hundreds of things this truck can carry, for it can be loaded up to 400 pounds. Featured, of course, are the "Doenut" pneumatic tires—they allow the truck to pass over bumps and through doorways just as if there were no surface obstructions (9623)

• LATEST development in freezing processes for preservation of foods freezes fresh vegetables in water and fruits in syrups in 50-lb. blocks or pint, quart, or gallon containers. To cook vegetables, customer simply lets ice thaw, cooks them in water from the melted ice. (9617)

• NEAT little five-year calendar is just the thing for your desk. It's artistically housed in a case of shiny black plastic. Successive months are mounted on a continuous strip which can be rolled forward or backward. (9618)

• BOTTLE CAP combining those two features hard to find together—easy opening and tight re-sealing—is on the market. (9619)

• WRAPPING material for food products strikes a new fashion. Cellulose coated with silver on one side and brilliantly colored on the other embodies heat-reflecting qualities with eye appeal, and of course it's moisture-proof. (9620)

• DESIGNED to protect iron and steel from corrosion, air-drying enamels made of rust-inhibiting pigments and a synthetic resin vehicle form a tough coating of pleasing appearance. They dry in four hours. (9621)

• HANDBOOK and survey guide for electrical modernization has its 32 pages full of useful electrical information for the operating man. There's a nominal fee for it but we think it's worth it. (9622)

Operating Shorts

Suspended Motor Simplifies Testing of Speed Reducers

J. A. HONEGGER, *New York*

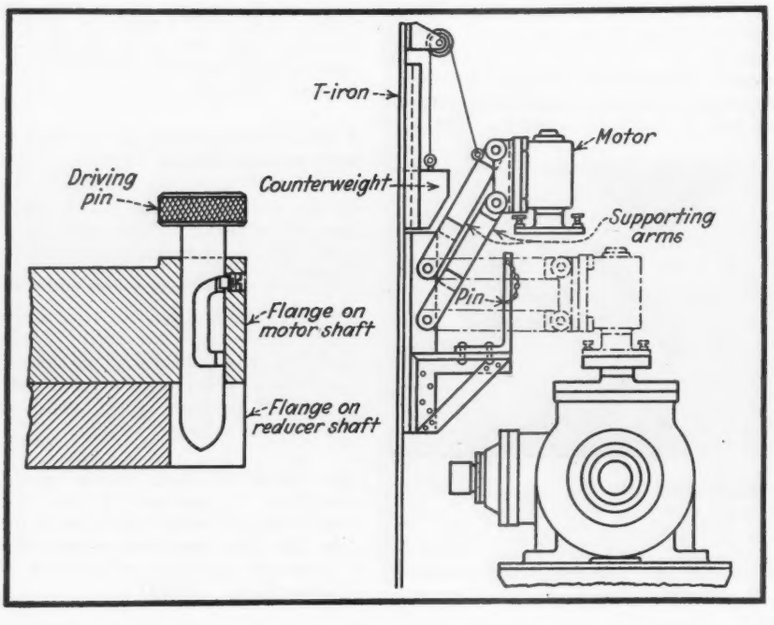
Saving of much time and effort in giving speed reducers a running test resulted from the adoption of the motor mounting shown in the illustration.

Reducers are assembled on skid platforms, which are taken to the testing floor on a lift truck. The problem of providing an easy and quick way of connecting and disconnecting the driving motor and the reducer was eventually worked out by mounting three of these driving assemblies along one wall.

The assembly consists of a T-iron, bolted to the wall, to which are pivoted two arms that carry the motor. A steel cable attached to the upper arm passes over a pulley and carries a counterweight which balances the weight of the motor. To limit sidewise movement of the motor in its running position the arms supporting it fit into a slot in an L-shaped piece mounted on an angle-iron bracket. A pin inserted in the L-shaped piece above the lower arm prevents the motor from accidently moving up, out of engagement with the reducer.

As will be seen, a simple method is used for connecting the motor to the reducer. A flange attached to the motor shaft carries two bayonet-lock driving pins, that fit into holes in a corresponding flange on the driven shaft of the reducer. These pins can be inserted or withdrawn by giving them a partial turn.

Mr. Honegger's contribution has been awarded the $10 *payment offered by the editors for the best Operating Short submitted during the past month.*



Wage Rate Standards for Carburizing Operations

ROBERT S. MILLER
Port Dalhousie, Ontario, Canada

There are several methods of establishing standards for labor performed on carburizing operations that can readily be adapted to similar continuous-process work. One simple method is to keep record of total number of pieces carburized, convert this figure to pounds, and knowing total labor cost, calculate labor cost per pound. In this way a standard for rate setting is easily arrived at, but to insure its accuracy the product must maintain the same size and weight; otherwise, the standard will vary.

The ideal standard is one that remains correct regardless of changes in weight, size, or shape of the parts processed. The following example shows how it may be determined.

Standards are wanted for a carburizing furnace of the continuous-pusher type. Pots for this furnace are loaded two to a tray upon two rows of trays which move over rollers along two tracks into the furnace. The furnace is of sufficient length to accommodate 27 trays on each track. With two tracks of 27 trays each and two pots per tray there can be 108 pots in the furnace at one time.

A pusher driven by a motor through a reducer can be set to operate at any time interval required; hence the furnace output is entirely dependent upon length of time between pushes.

Assuming that the speed reducer is set to operate the pusher at 50-minute intervals, it will require 50 times 27 or 1,350 minutes or 22.5 hours to push all of the 108 pots through the furnace.

Next step is to observe and log actual man-hours necessary to operate the furnace for a 24-hour period. If our time study shows two men each being paid for nine hours on the day shift, two men working eleven hours each on the night shift, and one man working the interval between shifts from 5 to 7 p.m. to operate the furnace, this is equivalent to 42 man-hours for a 24-hour period, or 1.75 man-hours per furnace-hour.

As the furnace cycle is 22.5 hours, the man-hours necessary to operate the furnace for its complete cycle are 22.5 times 1.75 or 39.375. Standard time per pot is 39.375 divided by 108 or 0.365 hours, and to arrive at the standard per piece it is only

necessary to divide 0.365 by the number of pieces packed per pot.

Standards determined in this manner are exact, can be easily determined, and need never be changed unless the production interval is changed.

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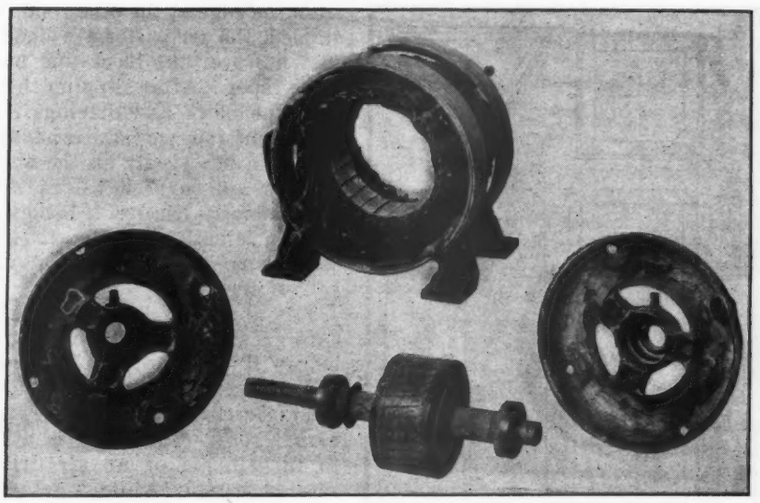
To Minimize Waste Motion in Assembly

SOURCE, *Lyon Metal Products, Inc. Aurora, Ill.*

Special assembly storerooms are a pronounced advantage when tied into the production plan, as in the plant of a Western manufacturer of a heavy steel product assembled from 30 or more irregularly shaped parts. Four double-faced racks are installed between the various points at which the product is assembled.

When the plant is working continuously on the same model, parts enough for a day's production are taken from finished parts stock and placed in the assembly line bins just before the close of the working day. When the work order is for a quantity less than a day's production, the parts necessary to complete the order are placed in the bins as they are emptied when finishing up the previous order. Deliveries of parts to these assembly line racks is organized on a once-per-day or a once-per-work order basis.

Each bin is labeled plainly so that an assembler can always find a certain part in the same place. Ordinarily, when parts are set around on the assembly floor, much time is lost in hunting and sorting, or in walking an unnecessary distance. Each part is found in its regular bin at a minimum distance from its assembly point.



Where two or more gangs are working on the same model, the number of parts remaining in the bins indicate whether one gang is ahead of the other, thus providing a simple check for encouraging competition. Also, parts left, subtracted from the number put in, indicate amount of work done, or completed units assembled. With such an accurate check on daily performance, determination of bonus payment for extra performance is a simple matter.

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Changed Operating Conditions Caused Motor Breakdown

SOURCE, *The Lincoln Electric Company Cleveland*

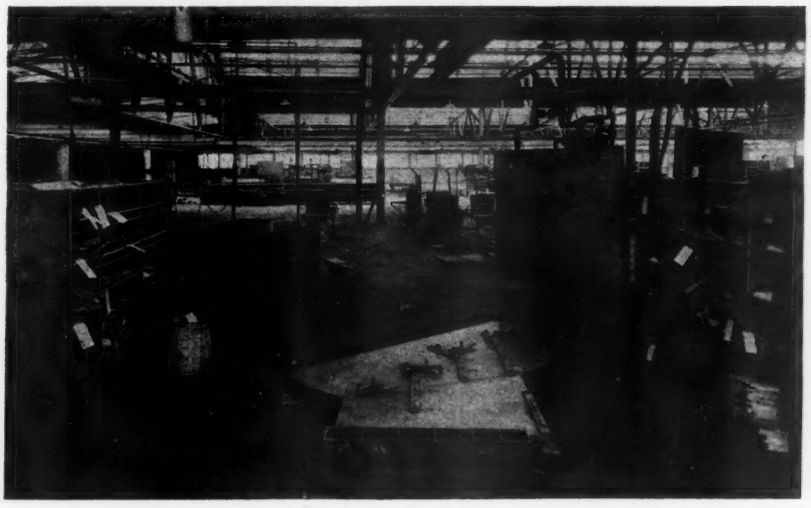
Importance of installing electric motors with due regard to service requirements was recently emphasized in a large plant. A fairly new motor, capable of giving long service in its original application, suddenly broke down when moved to a location where operating conditions were entirely different from those for which it was designed.

Originally, this motor, which was an open squirrel-cage type rated 1 hp., was installed in a location where there was little dust and no injurious element, such as acid fumes. Under such conditions it would have operated indefinitely. When the motor was moved during plant alterations, however, the operating conditions were changed.

In the new location it was subjected to acid fumes and soon stopped.

The illustration shows the motor dismantled after the breakdown. Damage caused by acid fumes can readily be noticed on the end plates, bearing housings, shaft, and retainers. The only part of the motor not affected by the acid was the windings. On these a special, acid-resisting insulation provided complete protection even under unusually severe conditions.

In view of this experience the old motor was replaced with a totally inclosed unit designed particularly for the new operating conditions.



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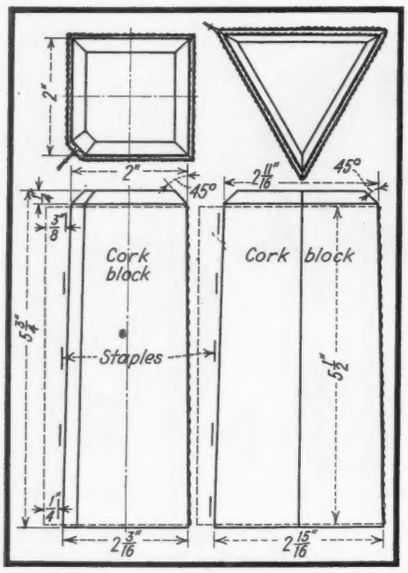
Reclaiming Abrasive Cloth Saves $3,000 Yearly

DANIEL D. EYSTER
Methods and Equipment Engineer
Seaman Body Corporation, Milwaukee

Abrasive cloth seems like a trifling expense item, but in our plant approximately $3,000 a year is saved by systematic handling of this material.

In finishing the steel body of an automobile, as in many other types of metal stamping and finishing operations, large quantities of abrasive cloth are used in smoothing

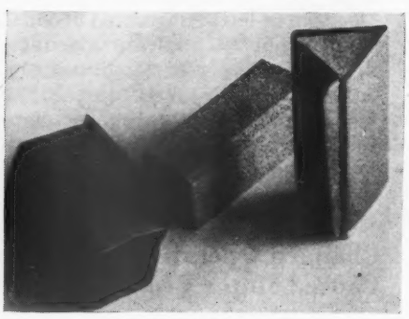


edges and welded joints. The cloth is usually held in the hand or wrapped around a file or wood block.

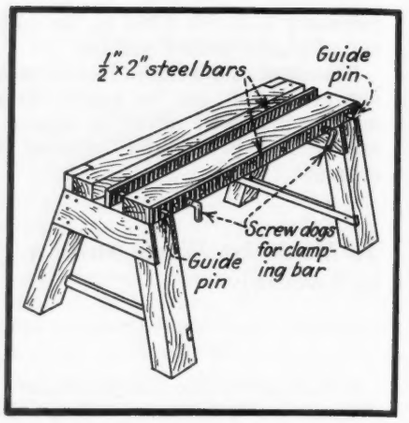
As a substitute for these rather haphazard methods of holding the cloth, cork composition blocks were made. These blocks are either rectangular for work on flat surfaces, or trianglar for getting into corners. The blocks have a slight taper from end to end, and one edge of the rectangular block is chamfered sufficiently to accommodate the abrasive bands.

The two ends of half of a 9x11-in. sheet of abrasive cloth are fastened together with ordinary paper staples. These staples are applied along a line that is not quite parallel with the edges, but starts ¼-in. from the edge at one end and finishes ⅜-in. from the edge at the other end. When stapled, the strips form a band that just fits over the block and has the same taper. After slipping the band over the block and driving it tight by a light tap, we have a handy tool on which practically all the abrasive surface can be used. Cork is used for the blocks because it is both light and sufficiently yielding to give a touch corresponding to that of the heel of the hand.

The abrasive cloth becomes filled with grease, dirt, and metal particles before it is worn out. To reclaim the strips, they are put over a brass cone corresponding in size to the cork blocks. This cone is attached to the spindle of an air drill and rotated rapidly while a jet of live steam plays against the cloth and removes the dirt. The cloth cones are then dried and put back into use, giving about 60 per cent of the wear obtainable from new cloth.



Abrasive disks also can be cleaned by steam in this manner. They may be cut down successively from 8-in. to 7- and 6-in. circles to present a fresh surface.



Sawhorse with Vise Has Many Uses

C. H. WILLEY, *Concord, N. H.*

The specially constructed sawhorse shown in the sketch has been found to be extremely useful. It has a clamp or vise attachment made from cold-rolled steel bars. The adjustable jaw slides on two guide pins and is clamped tight by two screw dogs.

Besides serving as a heavy-duty sawhorse this device can be put to a variety of other uses. One of the most important is holding lumber edgewise while it is mortised or planed.

To prevent corrosion of lamp bases in their sockets, apply a colloidal graphite coating to the threaded portion. Mix the graphite with water, brush or spray it on, allow it to dry before inserting lamp.

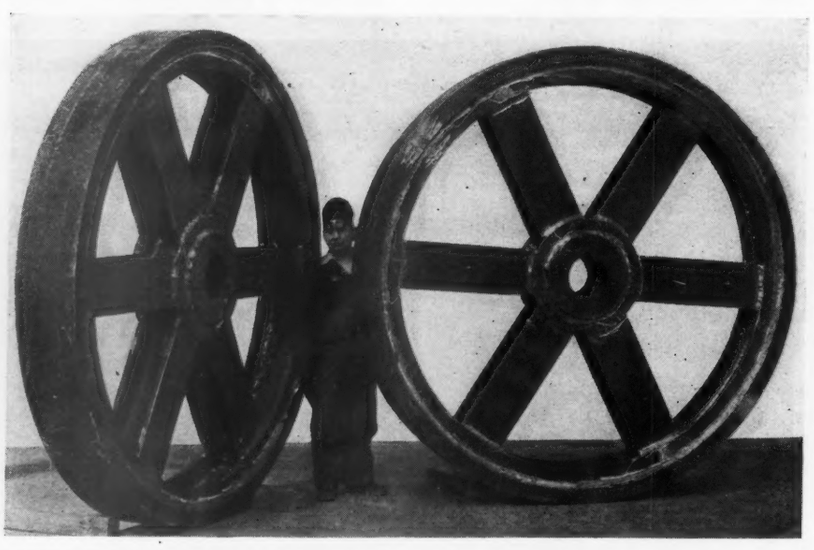
Large Steel Gear Blanks Fabricated by Welding

SOURCE, *Air Reduction Sales Company New York*

In an emergency, these large blanks for herringbone gears used to drive a cement mill were cut and fabricated in four days.

The outside rings were formed from plates 4¾ in. thick, rolled to size and shape. Spokes and stiffener plates were cut from 1¾-in. plates. It will be seen that the spokes and rims were fabricated to form I-beam cross-sections. Hubs are steel castings.

These gear blanks are 8 ft. in diameter, and the net weight of each is 7,647 pounds.



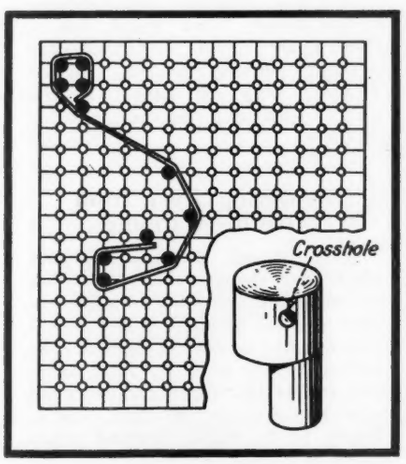
Handy Bending Jig for Light Material

JOHN E. HYLER, *Peoria, Ill.*

A jig for bending light-weight material into any desired form can be made from a large, flat, steel plate, ruled off in small squares, with holes drilled at all rule intersections.

Pins or studs with a shoulder are inserted in the proper holes and the material bent around them, as shown. In order to make the device universal, it is well to have on hand a number of studs with shoulders turned eccentrically, and with crossholes drilled as shown. Into these crossholes light pins can be inserted, by which the studs may be turned in their seats, altering the position of the shoulders as required to bring the bent stock to the exact form desired.

Different effects can be obtained through the use of studs having the protruding portion of greater or less diameter. All pins, of course, have the portion that enters the drilled hole of equal diameter. In some work a combination of straight lines and abrupt curves is wanted, whereas in others a smooth curve is needed. The latter can be obtained by using studs of greater diameter.



Pins are put into place as the bending proceeds, the desired curve first being laid out on the surface of the jig by some sort of templet. Each plug is inserted in order and is turned and positioned so that its outer portion comes tangent to the line of the design laid out on the plate.

When sharp, angular bends must be made, a special stud having a triangular or wedge-shaped top should be used. The material is then bent around each point by light strokes from a fairly heavy mallet.

SPECIAL NOTICE

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$10 will be paid for the best Operating Short submitted during the month of September. The Editors are the judges. Other Shorts accepted will be paid for at attractive rates

Preventing Condensation of Moisture in Conduit

J. L. YOUNG, *St. Marys, Ohio*

Water collecting in conduit is often the cause of low insulation resistance and conductor failures. The only method of preventing it is to eliminate condensation by preventing the circulation of humid air through the conduit.

The water vapor content of air entering the conduit, and the amount of condensation, depend primarily on the temperature and atmospheric conditions. Where there is considerable change of temperature within a short time, say overnight when the power load is removed and the conduit cools, considerable condensation may take place if the humidity is high. Also, when the conduit system is so arranged that some sections are always at a lower temperature than others, due to surroundings and location, some water formation is inevitable.

By making all of the conduit junctions to pull boxes, outlets, and so on airtight with a good insulating compound, entrance of moisture-laden air can be stopped.

Sealing of the conduit should be done when the air is dry, say late in the afternoon on a hot, dry day. Warming the conduit slightly with a torch near the ends will help to bond the insulating compound to it. Cotton waste or oakum packed around the wire will prevent the compound from running back into the conduit.

Add a little glycerine to the mucilage you use in your packaging operations—it keeps mucilage from drying out so rapidly.

For Routine Jobs, a Handy Reminder

MARK BELL, *Rutherford, N. J.*

In every plant, both on maintenance and in the power house, certain jobs have to be done periodically if the equipment is to be kept in tip top condition. Such work as inspection of inaccessible bearings for oil, refilling flexible couplings with oil or grease, testing scales, and other similar tasks should be done on a fixed schedule. While this duty can be taken care of by means of a work book, it is as well to have more visible reminders. The following little device, taking less than an hour to construct and costing less than 50 cents, may be a help.

Take a board about 24 in. long, 9 in. wide, and ½ in. thick. Bore a hole so that it may be hung, vertically, on the wall. Take four narrow strips of wood and rabbit them so they will serve as guides to hold ⅛-in. sliding strips.

Nail these on the board so that there will be three columns extending down the length of the board, each column being about 2½ in. wide. Take another thin strip about 3 ft. long, 2¼ in. wide, and ⅛ in. thick and paint it white. It is better to use a washable paint for this purpose although, if necessary, the wood can be left unpainted and merely rubbed with chalk each time.

Saw off this strip in pieces about ½ in. wide. When this is done there will be over five dozen pieces measuring 2¼ in. wide by ½ in. deep. At the head of each column print respectively:

IMMEDIATE
NEXT WEEK
NEAR FUTURE

Write the name of each job on a strip and slip it into the correct column. A stop at the bottom will prevent the strips from falling out. The most urgent job is placed at the top of the IMMEDIATE column. When it is done, the strip is removed and slipped into the future column with the date required written on the strip. To insert a slip into the center of any column, lift those above the point where it is to go and put it in on an angle. Letting the top ones down will drop it into position.

Of course any name may be placed at the head of the columns, and it may be found that four, five, or more columns are necessary. But the whole assembly will be found very handy and well worth the trouble of making it.

Questions & Answers

CONDUCTED BY

G. A. Van Brunt

How Meet the Situation When Organizers Get Busy?

We operate a small plant employing about 50 men. A union organizer is attempting to form a union among our employees. Our industry has never been unionized. How would you handle this situation?

IT IS rather common practice to start a drive for union membership with the smaller plants, which are likely to yield to the workers' demands rather than fight them. The advice given by an experienced labor negotiator may be helpful. It is as follows:

Don't get excited. Examine the situation in your shop with an eye to the facts. Are wages in line? Are there sore spots due to arbitrary or harsh rulings, discriminations, unjust treatment by foremen, promises that have not been kept, and the like?

Probably there are ten strikes and labor troubles due to such matters, to one dispute about wages and basic conditions. A good many such troubles, if they exist, will come out in a frank discussion of the demands presented by the representatives of the men. Perhaps a strike is the only way they know of getting a hearing on these questions. When such matters are brought out in the open, and if necessary remedied by the management in a spirit of fairness, the more formidable demands for wage increases can be examined in the light of the facts. Often the men will be more than willing to drop or modify them.

The question of union recognition is a knotty one that can only be answered individually. It costs money for workmen to maintain a union; they will do so only if they feel that the investment pays. The logical answer to a desire for unionization is to make this step unnecessary. Men will usually listen to reason, if it is supported by facts and a good past record of fairness. There are strongly organized industries in which a refusal to go along with the industry would be a constant invitation to battle. Indeed, there are trades in which the union may be an effective ally of the employer in helping to maintain wages and prices against the ignorant or inveterate price cutter.

In general, one must concede in principle the right of the employee to organize if he feels that it is necessary in defense of his interests. On the other hand, the employer can hardly be blamed for preferring to keep negotiations with his men on a direct basis, if he can, and thus save the overhead of the union organization, the restricting rules, and the interference by outsiders who very likely do not understand the business, which are likely to go with recognition of the union.

The fact that one is dealing with a group that is easily moved emotionally, inexperienced in trading, and often ill-informed on economic realities makes it all the more necessary to approach such negotiations with an open mind and an even temper. During the past three years there have been more than enough tragic examples of the futility, and the tremendous cost in disruption of the organization, and confidence, of employers taking an outraged, die-hard attitude. Unfortunately, it is all too easy in the first panic of a threatened

(Continued on page 70)

ANSWERS WANTED

Testing Schedule for Breaker Oil

Can you tell me how many times, as a general rule, medium-sized oil switches and circuit breakers can be operated before inspection and testing of the oil are required? We have a number of these devices, rated 600 and 4,500 volts, 200 to 800 amp. Some of the breakers open only five or six times a year. Switches may be operated twice a day.

In trying to work out an inspection schedule these questions have come up: Is it advisable to base inspection on the number of operations, rather than some definite period of time? Does the oil in circuit breakers deteriorate in any way even if the breaker opens only at long intervals? What would be a desirable frequency of inspecting the breakers and switches referred to above? How should the oil be tested or treated? —G.F.H.

Permissible Unbalance of Three-Phase Circuit

Difficulty is experienced in maintaining phase balance on one of our 440-volt, three-phase circuits. There are some heavy single-phase loads which come on at irregular intervals and cause unbalancing for an hour or more at a time. Recently current readings showed loads of 610, 570, and 665 amp. on the three legs of this circuit. It supplies about 25 three-phase motors of 10 to 20 hp., and a large number of small, single-phase motors, in addition to the loads mentioned above.

Do these readings show serious unbalancing? How much can a three-phase circuit be unbalanced without causing trouble? What troubles may we expect if the phases get any farther out of balance? —J.P.

Removing Dust from Overhead Piping

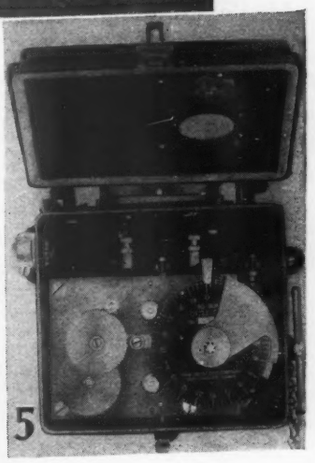
Keeping our garment factory clean presents a problem on which we should like to have help. Every time a piece of cloth is cut a certain amount of dust is formed, consisting of bits of fiber. This material settles thickly on the overhead piping and structural work, and is likely to be blown around when there is a draft.

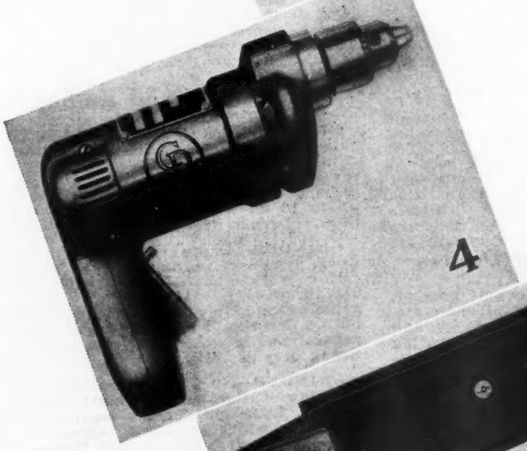
Use of vacuum cleaning is not very satisfactory. It takes a long time to go over all of the overhead piping. The operator has to stand on a ladder or use a piece of stiff tubing with a suitable fitting at the end, which hampers him and the other workers.

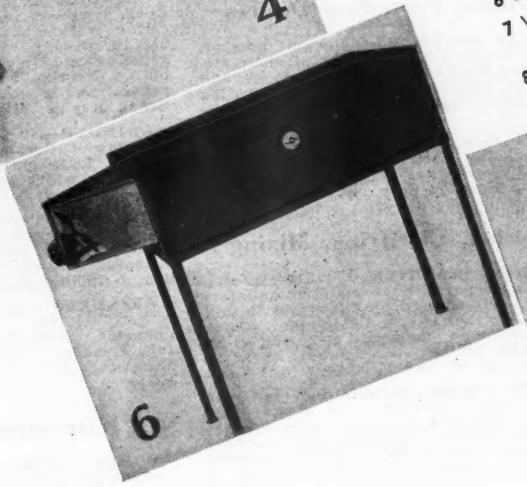
We have considered using vacuum cleaning once a month, and brushing the dust off once a week, but are not sure that this scheme would be satisfactory.

How would you solve this problem? —C.Q.C.

Flashes from the equipment makers







1 Pillow block. The Fafnir Bearing Co., New Britain, Conn.
2 Battery discharge indicator. The Electric Storage Battery Co., Philadelphia
3 Type RB safety switch. The Trumbull Electric Mfg. Co., Plainville, Conn.
4 The Midget electric drill. Chicago Pneumatic Tool Co., Waterbury, Conn.
5 Model 6088V process cycle controller. The Bristol Co., Waterbury, Conn.
6 Blueprinting machine. Milligan and Wright Co., Cleveland
7 Vibro-Insulators for vibration isolation. The B. F. Goodrich Co., Akron, Ohio
8 SA-150 arc welder. The Lincoln Electric Co., Cleveland

What's NEW in Equipment

Air Conditioning, Ventilating, Heating

COPPER COILS — Permanent metal-to-metal contact between fin and tube, obtained by hot tinning after fabrication and assembly. Face areas from 1 to 10 sq. ft. up to 12 rows deep. Face velocity of 500 ft. per min. available from 6,000 B. t. u. per hr. and up. Standard Galvanizing Co., West Van Buren St., Chicago.

UNIT COOLER—Suspended type. Has motor and fan, and air is cooled by circulation of cold water. Has vertical fins and insulated drain tank. Can be rotated through 360 deg. and used as a unit heater in the winter. Modine Mfg. Co., Racine, Wis.

Bearings

GREASE-PACKED BEARINGS—Line of wholly inclosed sealed precision bearings are now being packed with a stable grease and wrapped in aluminum foil. Norma-Hoffman Bearings Corp., Stamford, Conn.

Communication and Signaling

COMMUNICATION SYSTEM—"Belfone." For simple installations in small plants or for multiple hook-ups. Transmitter is size of smallest midget radio. More than one loudspeaker can be used. Bell Sound Systems, Inc., East Goodale St., Columbus, Ohio.

Electrical Control

FUSE CUTOUT—Type RP circuit reclosing fuse cutout. Time-delay provides interval between blowing of fuse and reclosing. Rated: 5,000 volts, 50 amp. Line Material Co., South Milwaukee, Wis.

PHOTOELECTRIC CONTROL — Model 729. Unit consists of photocell of high output characteristics (output capacity 500 watts), relay unit in separate panel box, and light source of standard design. Light intensity of 100 foot-candles will operate unit. Weston Electrical Instrument Corp., 635 Frelinghuysen Ave., Newark, N. J.

RECTIFIER — Grid-controlled mercury arc rectifier set with ratings of 150 kw. at 250 volts, 300 kw. at 550 volts d.c. Allis-Chalmers Mfg. Co., Milwaukee.

RELAY—Electric relay with silver alloy, double contact points. Will handle 1-kw. non-inductive load or ½-hp. inductive load. For 110-volt, 60-cycle operation. S. L. Bartlett & Co., West Washington St., Chicago.

RELAY—High-speed, 3-phase, directional distance relay. Has 3 starting units, 3 resistance units, and a timing unit. Also has two instantaneous overcurrent units. Type GCX 12-A. General Electric Co., Schenectady, N. Y.

RELAY—Type A a.c. relay for operation on voltages 2-230, 25-60 cycles. Can be furnished with as many as 4 pairs of contacts with capacity of 10 amp. per contact. G-M Laboratories, Inc., 1735 Belmont Ave., Chicago.

SWITCH — Two-circuit water heater switch consisting of two 2-pole switches in one case. Can be padlocked in on or off positions. Cutler-Hammer, Inc., Milwaukee.

SWITCH—Type 600-1 oil-immersed float switch for corrosive or hazardous areas. For operation of sump pumps, tanks, etc. Operates on 600 volts. Available with 1, 2, or 3 poles. Rowan Controller Co., Baltimore.

SWITCH—Type "CJH-14" line of indoor disconnecting switches arranged for mounting on flat surfaces or pipe. Ratings from 7.5 to 34.5 kv. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

SWITCH—Type LF-23 manually operated field discharge switch for motor and generator circuits. Rated at 250 volts d.c., 100 and 200 amp. General Electric Co., Schenectady, N. Y.

SWITCH—Type LG218 indoor disconnecting switch for hook or group operation. Rated 7,500-34,500 volts. Silver-to-silver line pressure contacts. General Electric Co., Schenectady, N. Y.

SWITCHES—CR2940 watertight pushbutton master switches mounted in molded plastic inclosures. Provide both normally open and normally closed circuits. General Electric Co., Schenectady, N. Y.

SWITCHES—Types "A" and "R.B." safety switches for Class II, Groups F and G hazardous locations. Dust-tight, water and weatherproof. Heavy-gage steel boxes. In 3-pole, no fuse, 30-200 amp. ratings. The Trumbull Electric Mfg. Co., Plainville, Conn.

VOLTAGE REGULATOR — Consists of single-phase, full-wave rectifier deriving power from a.c. generator and delivering d.c. to shunt field of exciter. Type EF. Ward Leonard Electric Co., Mount Vernon, N. Y.

Electrical Distribution

BUSBAR SUPPORT—High strength busbar supports for installations where exceptionally high short circuit stresses may occur. Insulators are interchangeable. Delta-Star Electric Co., 2400 Block, Fulton St., Chicago.

CONDUIT—"Transite Korduct." Thin-walled, for duct systems inclosed in concrete. Said to be rot-proof, incombustible, immune to electrolysis and corrosion. Johns-Manville Corp., 22 East 40th St., New York.

TRANSFORMER — "Universal" current transformer. Has nine primary ranges between 10 and 800 amp. Tested at 10,000 volts a. c. between windings and between windings and case. Rated 25 volt-amp. Cast aluminum case. The Esterline-Angus Co., Indianapolis.

Electrical Protection Devices

CIRCUIT BREAKER—Oil circuit breaker. Claimed to give quick clearing of short circuits. For 600 and 1,200 amp. at 15 kv. and 2,000 amp. at 7.5 kv. Interrupting rating 100,000 kva. Condit Electrical Mfg. Co., Boston.

FUSES—Line of secondary fuses. Weatherproof bakelite cartridge with inner fiber tube. Sixteen sizes ranging 5-200 amp. James R. Kearney Corp., St. Louis.

Filtering, Clarifying, Mixing

CLEANING MACHINE—For free flowing materials. Separation of material and foreign matter is affected by differences in unit weights of the two. Air stream passes upward through material removing lint, fluff, small sticks, etc. Jabez Burns & Son, Inc., 43d St. and 11th Ave., New York.

FILTER PRESS—Suitable for clarifying heavy cellulose solutions and similar materials. Corrosion-resistant screens are fitted over plates. Several sizes to meet specific area and holding capacity requirements. T. Schriver & Co., Harrison, N. J.

FILTER PRESS PLATES—Made of corrosion-resisting metal to take the place of cast iron plates previously made. D. R. Sperry & Co., Batavia, Ill.

MIXER—Has ¼-hp., 1,725-r.p.m., 110-volt, 60-cycle motor driving a 4-in., 3-blade propeller which is mounted on a stainless steel shaft. Motor housing has clamp by which it can be attached to a tank. No. 11. Eastern Engineering Co., New Haven, Conn.

Fire Protection

NOZZLE—"Phomaire Play Pipe" nozzle for fighting flammable liquid fires. As water passes through pipe, "Phomaide' foam-making solution, carried by operator on hip pack, is drawn into water stream to form foam. One gal. of "Phomaide" makes 350 gal. of foam. Pyrene Mfg. Co., Newark, N. J.

Food

BAR WRAPPING MACHINE—Improved Model GH. Handles bars up to 10 in. in length. Uses printed, transparent wrapping material in roll form. Inner liner can be used. If printed paper wrappers are used, machine is built with sheet feed. Package Machinery Co., Springfield, Mass.

CAN FILLING MACHINE—Model H-S 12-tube can filling machine. Can operate at rate of 120 cans per minute. Can be furnished with parts coming in contact with product made of bronze, nickel, or stainless steel. Horix Mfg. Co., Corliss Station, Pittsburgh.

SIFTER—Portable aerating sifter for flour. Has 3-tray sifting action. Has 3 legs so that it can set solid and level on uneven floors. Read Machinery Co., Inc., York, Pa.

Grinding and Buffing

BUFFING MACHINE—Sheet buffing machine to buff metal in the sheet before fabrication. Sheets are placed and held on a revolving drum which brings them into contact with buffing wheel. Takes sheets up to 16 in. wide, 7 ft. long, and 0.020 in. thick. Divine Brothers Co., Utica, N. Y.

GRINDER—Disk grinder taking circular work up to 15 in. in diameter and duplicating work up to 7 in. wide. Table is 9¼ in. wide by 21 in. long. Suitable for grinding and finishing segments, angles for built-up work, circular and taper work, and general angle work. Oliver Machinery Co., Grand Rapids, Mich.

GRINDER—No. 700 swing-arm grinder for grinding off tops of glass bottle molds. Has 1½-hp., 3,600-r.p.m. motor mounted on vertical slide which has hand micrometer screw feed. Hanchett Mfg. Co., Big Rapids, Mich.

GRINDER—Type C. Floor type grinder using 24- or 30-in. high speed wheels. Four changes of speed accomplished by changing sheaves on the 15-hp. motor. Ransom Grinding Machine Co., Oshkosh, Wis.

GRINDERS—Disk grinders in sizes of 1, 2, 3, 5, 7½, and 10 hp. Disks 10-30 in. in diameter. May be arranged as combination grinders and disk grinders. Standard Electrical Tool Co., West 8th St., Cincinnati.

Instruments and Meters

COMPENSATOR — Automatic pressure compensation for errors due to variations

in static pressure in the measurement of flows of compressible fluids. Consists of spiral pressure tube connected to a lever. The Foxboro Co., Foxboro, Mass.

CONTROLLER—Model 6088V process cycle controller. Automatically controls any cycle operation which operates on a cycle that must be changed from time to time. Cam operates one or two 3-way pilot valves. The Bristol Co., Waterbury, Conn.

CONTROLLERS—"Master Free-Vane Controllers" for temperature, time-temperature, flow, liquid level, pressure, time-pressure, and humidity. For applications where greatly reduced sensitivity is required. Pneumatic type. The Bristol Co., Waterbury, Conn.

CONVEYOR SCALE—Has integrating mechanism consisting of cone and rotating switch driven by a flexible shaft from the conveyor. Integrating wheel revolves at speed proportional to load. Fairbanks, Morse & Co., Chicago.

FLOW METER—Figure 769 Fast-Flo Xacto Meter. Fast flows at low head pressures. Counter can be set in any of 16 positions. Flanged for 2½-in. pipe. S. F. Bowser & Co., Inc., Fort Wayne, Ind.

GAS ANALYZER—Model RZA. Makes continuous, automatic analysis of prepared atmospheres. Two forms: one for neutral and reducing atmospheres, one for oxidizing atmospheres. There is also a combination instrument. Bacharach Industrial Instrument Co., Pittsburgh.

METER—"Densimeter" measures density of boiler water. Small floating glass bulb sinks to bottom of beaker filled with warm boiler water. Water is stirred with thermometer until bulb floats; concentration is then read on thermometer. National Aluminate Corp., West 66th Pl., Chicago.

MICROMETER—One-hand operation, visible reading at arm's length, reading in thousandths, U. S. Standard gage, or millimeters. If provided with enlarged measuring surfaces it can be used to measure sheet rubber and coated fabrics. Haines Gauge Co., South Fourth St., Philadelphia.

MICROMETERS—Nos. 12 and 13 micrometer calipers in new design. No. 12 ranges 0 to 1 in. by thousands, No. 13 from 0 to 1 in. by ten-thousandths. Browne & Sharpe Mfg. Co., Providence, R. I.

PLUG GAGES—Twenty-three different standard sizes of plug gages. Cover range of 2½ to 12½ in. Button or pin-type anvils. Gages have crackle finish. Sheffield Gage Corp., Dayton, Ohio.

REFLECTOMETER—Photoelectric photometer for measuring reflectance, opacity, and color of paints, pigments, and textiles. Henry A. Gardner Laboratory, Inc., New York Ave., N. W., Washington, D. C.

RELAY TEST BOX—Portable testing box for distance, reactance, or impedance relays. Used for external resistors and reactors. With it all tests related to setting the relay can be made. General Electric Co., Schenectady, N. Y.

THERMOMETER—Nitrogen-gas-filled recording thermometer. Helical coil is "cartridge sealed." Operating ranges —20 to +1,000 deg. F. Reading instrument can be placed 200 ft. from point of measurement. Republic Flow Meters Co., 2240 Diversey Parkway, Chicago.

THERMOMETER TUBE—"Binoc" thermometer tube increases readability of thermometer. Can be read with both eyes; mercury column is magnified. Taylor Instrument Cos., Rochester, N. Y.

TIMER—Motor-operated timer of immediate recycling type. Has synchronous motor driving cams through a chain of gears. Timing is adjustable over a wide range. Struthers Dunn Co., Philadelphia.

WATTMETER—Dynamometer type. Watt ranges: 0-300, 0-750, 0-1,500 with 150-volt limit. Also available for 220-volt single-phase. Hickok Electrical Instrument Co., Dupont Ave., Cleveland.

Lighting

PHOTOFLOOD LAMP—"Photoflood No. 2." Consumes 500 watts. Can be used on lighting circuits of 105 to 120 volts. Inside frosted. Life, 6 hours. General Electric Co., Nela Park, Cleveland.

REFLECTOR—No. 1585 X-Ray Reflector Design. For use with 500- or 300-watt mercury vapor lamp. Aluminum housing. Diameter and height both 13⅝ in. Curtis Lighting, Inc., 1123 West Jackson Blvd., Chicago.

Lubricants and Lubricating Devices

LUBRICANT—Contains heavy crude oil and colloidal graphite. Grades for internal combustion engines and speed reduction units. Graphoid Lubricants, Inc., Franklin, Pa.

LUBRICANT—"SL Super Lubricant." High film strength and adherence to metal surfaces. Contains no graphite. Used as additive—25 per cent with any regular crankcase oil. Grapho Products, Inc., 2232 Alvord Ave., Indianapolis.

OILER—"Drip-Drop" oiler is now being manufactured with feed control. Simple adjustment makes oiler feed slow, medium, or fast. Trico Fuse Mfg. Co., Milwaukee.

Materials

COATING MATERIAL—For application to steel before carburizing to prevent carbon penetration. Comes in form of a powder and a liquid, which are mixed in definite proportions. "K-Seal." Lindberg Engineering Co., Union Park Court, Chicago.

METAL FINISH—"Aspro Metal Finishes." Made of modified asphalt base. Available in black or colors. Resistant to destructive reagents. Can be applied by gun or brush. The Asphalt Products Co., New York.

MOLDING POWDER—Used to make objects resembling soft vulcanized rubber. Objects are resilient and elastic, can be molded in 3 minutes. Thiokol Corp., Yardville, N. J.

PLASTIC—Durez 1544. Has high impact strength and is machinable. Black. General Plastics, Inc., North Tonawanda, N. Y.

RESINS—Line of resins for impregnation of wood, pulp, and cellulose materials to give them greater strength and resistance. Resins are supplied in solution form. General Plastics, Inc., North Tonawanda, N. Y.

STEEL—Armco stabilized steel in cold rolled sheets and strip. Retains properties of temper rolled steel indefinitely. It has no sharp yield point. American Rolling Mill Co., Middletown, Ohio.

Materials Handling

ELEVATOR—Light duty freight elevator. Has large diameter, extended, worm shaft which carries motor armature and brake pulley. Semi-steel external gear is on machine beam and protected by guard. Otis Elevator Co., 11th Ave. and 26th St., New York.

TRUCK—All-steel platform truck with end and side rails pressed from one sheet of steel. Has demountable rubber wheels. Lansing Co., Lansing, Mich.

TRUCK—Shovel truck is pushed under load with the foot, and load is pushed off with the foot. Handles barrels, boxes, cartons, and bags. Pollard Bros. Mfg. Co., North Knox Ave., Chicago.

TRUCK, LIFT—Hand-operated lift truck for handling low 3½-in. pallets of tinplate, strip steel, and the like. Capacities of 2,500 and 3,500 lb. Single-stroke lift. Barrett-Cravens Co., 3255 West 30th St., Chicago.

VIBRATING SCREEN—Can be mounted on flat foundation or suspended from overhead. In two- or three-deck construction, in widths 3-5 ft., and lengths up to 20 ft. Drive is through an eccentric and operation is at 350-400 r.p.m. Hendrick Mfg. Co., Carbondale, Pa.

Mechanical Power Transmission

BELT PULLEY BANDAGE—"Contrasit" belt pulley bandage for application to pulley faces to eliminate belt slip. Made of asbestos cloth which is soaked in specially prepared liquid before application. Scann-American Sales Service, 200 Broadway, New York.

COUPLING—Flexible. Has intermediate part of oil-resistant rubber. In 3 sizes, ⅛-, 1-, and 5-hp. ratings at 1,750 r.p.m. Certified Flexible Couplings, Inc., 122 East 42d St., New York.

COUPLING—Flexible couplings for use where driver and driven units are not on same base and where there is possibility of considerable angular shaft misalignment. Made of two separate flexible units. For high or low speed transmission. Smith Power Transmission Co., West Third St., Cleveland.

COUPLING—Improved flexible coupling of chain type. Has two sprockets encircled by length of double-strand roller chain. Clearance between sprocket teeth and chain side plate permits misalignment of connected shafts. Diamond Chain & Mfg. Co., Indianapolis.

PILLOW BLOCK—Ball bearing pillow block with a one-piece housing of molded rubber. Bearing is of double-shielded type and pre-lubricated. For shaft sizes 11/16 to 1 7/16 in. The Fafnir Bearing Co., New Britain, Conn.

SPEED REDUCERS—Units range from 4- to 18-in. center distances. Available in all types such as horizontal or vertical shafts, worm on bottom, worm on top, and combination helical gear units for high ratios of reduction. Dominion Engineering Co., Ltd., Montreal.

VARIABLE-SPEED UNIT—Has extended lever between driving motor mounting and the vertical inclosed transmission, which can be connected to any movable machine element. Can be adapted to automatic or manual operation. Lewellen Mfg. Co., Columbus, Ind.

Metal Finishing

CHROMIUM ANODE—Made of tellurium lead. Corrugated surfaces are used to increase electrical efficiency. Hooks of copper sheathed to resist corrosion. J. C. Miller Co., Lake Michigan Drive, Chicago.

CLEANING COMPOUND—"Pal." Concentrated cleaner for use before electroplating. Dissolves grease, fat, oil, soap stains, etc. Linick, Green & Reed, Inc., Washington St., Chicago.

METAL CLEANER—"Metex Grade R." For general metal cleaning operations. Can be used in still, soaker-type bath, or in electro-cleaning. MacDermid Inc., Waterbury, Conn.

POLISHING MACHINE—Polishing and buffing machine for odd-shaped work. Used in conjunction with lathe, taking pieces as fast as they come from lathe. "Acme Automatic Type D-10." Acme Mfg. Co., Detroit.

Metal Working

AUTOMATIC SCREW MACHINES—Models 61 and 42. Model 61 has three six-spindle sizes: 1⅝, 2, and 2¼ in. Model 42 consists of two four-spindle sizes: 2⅝- and 3-in. bar capacity. Automatic electric stop. New Britain Gridley Co., New Britain, Conn.

BROACHING MACHINES—Complete line of standard broaching machines and equipment, comprising eleven basic types in 49 models. Machines can be changed over easily from one size to another. Individual motor drives. Colonial Broach Co., Detroit.

CHUCKING MACHINES—Nos. 49 and 675 differing principally in number of spindles and work capacity. No. 49 has four 9-in. chucks and 9¾-in. swing; No. 675 has six 7½-in. chucks and 7¾-in. swing. Driving mechanism inclosed behind sliding doors. New Britain-Gridley Machine Co., New Britain, Conn.

CUT-OFF SAW—"Straitline." Either steel saw or abrasive disk can be used. Two models: one for straight right angle cuts, other has swivel column for making angle cuts up to 45 deg. Oliver Machinery Co., Grand Rapids, Mich.

DEGREASING MACHINE—Size 624 "Detrex Degreaser." A two-dip model. For both immersion and vapor cleaning. Jacket-type water condenser runs completely around the machine. Detroit Rex Products, Hillview Ave., Detroit.

DIE-CASTING MACHINE—No. 8 automatic die-casting machine for large casting work where pressure areas are great. Alloys of zinc, aluminum, lead, or tin are handled. Standard operating speeds are 5, 3.33, 2½, and 1.66 shots per min. Madison-Kipp Corp., Madison, Wis.

DRILL—Production drill for continuous operation. Twelve speeds and 16-feeds are available. Capacity is 2 in. in steel; 7½-hp. motor recommended for heavy duty work. Furnished for flat, V-belt, or chain drive. Defiance Machine Works, Defiance, Ohio.

FURNACE, ELECTRIC—Salt bath furnace for cyaniding, annealing, and hardening. Bath is heated by metal electrodes immersed in salt. A.c. current is used. Six sizes. Loads range from 15 to 50 kw. Ajax Electric Co., Inc., Philadelphia.

FURNACE, MELTING—Aluminum melting furnace. Hand lever on an indicator scale may be set to regulate proper volume of gas and air. Several sizes, single or twin units. Melting pot capacity 30 or 50 lb. Kindt-Collins Co., Elmwood Ave., Cleveland.

HACKSAW MACHINE—Will cut stock up to 6 in. square or 6⅝ in. round. Drive by belt from lineshaft or by motor mounted at side. Saw stroke is 5 in. Blade is 14 in. long, 1¼ in. wide, has 4 or 6 teeth per in. Racine Tool & Machine Co., Racine, Wis.

HONING MACHINE—No. 2610 hydraulic honing machine taking all cylinders 3/10 in. in diameter. Variable-speed transmission provides for the spindle any speed between 100 and 250 r.p.m. Spindle travel is 20 in. and machine will swing 26 in. Has 10-hp. motor. Barnes Drill Co., Rockford, Ill.

KILN, ELECTRIC—Double-deck, roller-hearth type of kiln for decorating china and glassware. Maximum temperature 1,450 deg. F. Temperature automatically controlled. Electric Furnace Co., Salem, Ohio.

LATHE—Hydraulic multi-speed lathe. Drives furnished in 5-, 10-, 15-, and 20-hp. sizes. Specially constructed headstock leg houses variable speed transmission. Drive from transmission is by multiple V-belt. Monarch Machine Tool Co., Sidney, Ohio.

MILLING MACHINE—No. 12B high speed vertical miller and profiler. Available with either one or two spindles and can be supplied as single-purpose or general-purpose machine. Each spindle has its own driving motor which drives the spindle through multiple V-belts. Pratt & Whitney Division, Niles-Bement-Pond Co., Hartford, Conn.

PRESS—No. 11-1 inclinable press. All-welded steel frame. Capacity is 115 tons; bed area 29x40 in. Operation at speed of 40 strokes per min. Block-type clutch and large brake. The Cleveland Punch and Shear Works Co., Cleveland.

PRESS — Two-column vertical press. Capacity 60 to 300 tons. Automatic unloading control is adjustable. Stroke is 8 in. Two double-acting, rapid-traverse cylinders. Pump direct-connected to 20-hp. motor. Oilgear Co., Milwaukee, Wis.

THREAD GRINDER—Automatic thread grinding machine. Has truing device which keeps wheel sharp. Grinds threads up to 8 in. in diameter and 9 in. long. Grinding wheels 20 in. in diameter. Jones & Lamson Machine Co., Springfield, Vt.

THREADING MACHINE—Model 35 high production threading machine with self-contained selective-type gear box for speed changes. Construction provides for accurate die alignment. Die adjustment can be made without stopping machine. Acme Machinery Co., Cleveland.

Miscellaneous

ACID PUMP—Centrifugal pump made of Worthite, an acid-resistant nickel-chromium-molybdenum steel. Open-type impeller. Heads to 70 ft., capacities to 130 gal. per min. Worthington Pump and Machinery Corp., Harrison, N. J.

BLUEPRINTING MACHINE—New model added to line of blueprinters using incandescent lamps as light source and flat bed printing surface. Sizes 24x36 in. Milligan & Wright Co., 1247 West Third St., Cleveland.

COOLANT FILTER—No. 12, designed primarily for large grinding machines. Filtering bowl is 13 in. in diameter. Equipped with floorstand and all necessary fittings. Fostoria Pressed Steel Corp., Fostoria, Ohio.

CORE MAKER—Consists of three parts: cast iron base, iron table and vertical plate, electric or air vibrator. Core box may be rammed by hand or by blower. Harry W. Dietert Co., West Grand Blvd., Detroit.

DEAERATOR—Consists of vessel evacuated by one- or two-stage steam jet pump, or a mechanical pump. Croll-Reynolds Engineering Co., 17 John St., New York.

DISCHARGED BATTERY INDICATOR—For use on electric trucks. When voltage drops to a predetermined point, a red bulls-eye flashes. Made in standard sizes for 12-, 15-, 16-, and 18-cell batteries; special for other sizes. The Electric Storage Battery Co., 19th St. and Allegheny Ave., Philadelphia.

DRIER—"Aero-Therm" units, used in automatic stock driers deliver large volumes of air at high pressures. High-speed fans, fin-type heating coils located at side, individual motor drives for the fans. Philadelphia Drying Machinery Co., Philadelphia.

EXPANSION PLUGS—To close core holes and holes bored in castings. Make waterproof and airtight seal. Wrought Washer Mfg. Co., South Bay St., Milwaukee.

LEAD SEAL—"Bestolife" lead seal consists of finely divided metallic lead in practically a colloidal form. For use on all types of threads and gaskets. I. H. Grancell, East First St., Los Angeles.

METALLIC COATING—"Armco," a preparation for replacing tin or galvanized surfaces worn, damaged, or burnt away by welding. Brand "A" is tin and brand "B" zinc. American Solder and Flux Co., Wayne Ave. and Berkley St., Philadelphia.

SAND SEPARATOR—"Sep-Aerator" for foundries. Performs automatically two-fold function of aerating and mixing sand before delivery to molder's hoppers and separating from the sand metal, pebbles, and small refuse. Link-Belt Co., 2045 West Hunting Park Ave., Philadelphia.

SAWDUST—Complete line of sawdust. Hardwood, kiln-dried sawdust ranging from finest to coarsest grades. The Lea Mfg. Co., Waterbury, Conn.

SCREWDRIVING MACHINE — Magazine-feed power screwdriving machine equipped with universal barrel-type hopper. With but two sizes of collector rings it takes screws in sizes of No. 4 to ¼ in. Detroit Power Screwdriver Co., Rohns Ave., Detroit.

SHIPPING ROOM STAND—Tubular steel typewriter stand for shipping room use. Stand is 40 in. high, has a folding shelf on each side and a drawer at the center. Locking device lowers stand off casters to firm position on the floor. Sherman-Manson Mfg. Co., 621-631 South Kolmar Ave., Chicago.

VIBRATION DAMPERS — "Vibro-Insulators" for bases of machines, electric and combustion motors, generators. Consists of rubber bonded to two metal plates, one which is fastened to vibrating member, other to foundation. Three types. The B. F. Goodrich Co., Akron, Ohio.

WIRE PARTITION—Available in interchangeable sections. Panels can be had in four heights ranging 7—10 ft. Panels are 5 ft. wide. Doors can be placed between any two panels; they are 3—4 ft. wide, 6½ ft. high. Acorn Wire & Iron Works, Lowe Ave., Chicago.

Molding

MOLDING PRESS—For rubber and plastics. Sizes up to 4,000 tons pressure. Has link-shaped steel slab forging forming housing for ram pot, platens, and press head to equalize strain and increase factor of safety. Stewart Bolling & Co., Inc., East 65th St., Cleveland.

Motors

GEARED MOTOR REDUCERS—Single reduction, explosion-proof motors. For Class 1, Group D location. Sizes 1½ to 75 hp. Westinghouse Electric & Mfg. Co., East Pittsburgh.

GEARED MOTOR REDUCERS — Two types: one a single worm and wormwheel reduction, the other a double worm gear reduction. Sizes 1/50 to 5 hp. Janette Mfg. Co., 556 West Monroe St., Chicago.

MOTOR — Single-phase, capacitor-start motors. Main and starting windings. Sizes ½ to 5 hp. Crocker Wheeler Electric Mfg. Co., Ampere, N. J.

MOTOR—Type CR single-phase induction motor for heavy duty applications. Ratings ¾ to 3 hp., 110/220 volts, dual voltage operation on all commercial frequencies. Westinghouse Electric & Mfg. Co., East Pittsburgh.

Packaging

LABELING MACHINE — "Wide Range Quick Change Adjustable Labeler." Two adjusting handles provide simple, fast adjustments for cans of different sizes. One other handle moves label guide for different-sized labels. Burt Machine Co., Baltimore.

Paint and Painting Equipment

ENAMEL—"Ba-Flex Enamel," a baking enamel for metals. Only one bake is required. Can be used on etched or embossed surface. Buffs without chipping. Roxalin Flexible Lacquer Co., Inc., Elizabeth, N. J.

ENAMELS—Air-drying lacquer enamels for finishing zinc and aluminum die castings. Supplied in gloss and eggshell sheens and white, black, and 32 shades. Maas & Waldstein Co., Newark, N. J.

PROTECTIVE COATING—For steel. Applied by brushing, dipping, spraying. Leaves almost transparent film. "Paralan." American Lanolin Corp., Lawrence, Mass.

SPRAY GUN STRAINER—Type VS fluid strainer for attachment to fluid inlet of MBC spray gun. Consists of screen reinforced with coiled spring. The DeVilbiss Co., Toledo, Ohio.

Piping, Valves and Fittings

SAFETY HEADS—Spherical drawn diaphragms secured in specially designed flanges are said to burst within 5 per cent of rated pressure. Made in corrosion-resisting metals for variety of pressures. Black, Sivalls & Bryson Mfg. Co., Kansas City, Mo.

TRAP—Multiple bellows thermostatic trap for removing condensate from large steam coils or jackets. Made in sizes 1¼ to 2 in. in two pressure ranges, 0–60 lb. and 0–200 lb. Sarco Co., Inc., 183 Madison Ave., New York.

VALVE—Needle valve for water used for humidifying purposes. Solenoid-operated. Capacity is 35 gal. per hr. at 50 lb. pressure. Maximum capacity, 125 lb. for 110-volt, 60-cycle operation. Supreme Electric Products, Rochester, N. Y.

VALVE—"Thermoton" temperature control valve for jacketed kettles, open or closed tanks, and other heated process equipment. Can be adjusted to discharge condensate at any temperature down to 90 deg. F. Sarco Co., Inc., 183 Madison Ave., New York.

VALVES—"Solder-End." For 150-lb. service on copper pipe lines. Jenkins Bros., 80 White St., New York.

Portable Power Tools

DRILL, PNEUMATIC—Portable drill with ¼-in. drilling capacity. Weighs 4¼ lb.; can

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be operated by one hand. Model 016-4. Buckeye Portable Tool Co., Dayton, Ohio.

ELECTRIC DRILL—No. 801 CP universal electric drill. For ⅛-in. drilling. Weighs 2 lb. 10 oz.; overall length, 7⅛ in. "The Midget." Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Power Plant Equipment

COMPRESSORS—Three- and six-cylinder, vertical-angle, 2-stage compressors. Capacities from 142 to 445 cu. ft. per min. Automotive-type pistons; finned, radiator-type intercooler. Force-feed lubrication. Worthington Pump and Machinery Corp., Harrison, N. J.

COMPRESSOR SILENCER FILTER—"Protectometer Silencer Filter" filters air to the compressor and muffles the compression noise. Circular fin construction and cylindrical rectifying chambers which lower velocity of the air to reduce the noise are features of the construction. Staynew Filter Corp., Rochester, N. Y.

CONVERTERS—Convert 6, 12, or 32 volts d.c. to 60 cycles, 110 volts a.c. Rated at 40 watts output. Carter Motor Co., Chicago.

PUMP—"Motoair" combined motor and pump unit. Several capacities in single or double units. Air volumes 9-70 cu. ft. per min. Steel City Electric Co., Pittsburgh.

PUMP—Piston pump for well service to depths of 225 ft. Seven capacities from 115 to 550 gal. per hr. Motor sizes from ¼ to ¾ hp. Sta-Rite Products, Inc., Delavan, Wis.

TURBINE—Size D-1 steam turbine for pumps, fans, etc. Speeds up to 5,000 r.p.m., ratings 1-25 hp. Single-stage, impulse, double-impact type. Nickel-steel blade, monel nozzles. Dean Hill Pump Co., Anderson, Ind.

WATER COOLERS—Steam ejector coolers of both surface condenser and barometric condenser types. Surface condenser type in capacities ranging 6–135 tons, barometric type in capacities 20–135 tons, depending on steam pressure and chilled water temperatures. Graham Mfg. Co., Inc., Delaware Ave., Buffalo.

Printing

INTERTYPE MACHINES—Four models. Each carries four magazines to which may be added four side magazines. Increased matrix capacity, easy and quick changes of magazines from front of machine. "Four-Magazine Models C, F, G, and H." Intertype-Corp., 360 Furman St., Brooklyn, N. Y.

LINOTYPE MACHINES—"Blue Streak." Quick shifting of magazines. Moving parts are shielded and parts within operator's field of vision have subdued finish to eliminate glare. Swinging keyboard, unit control. Mergenthaler Linotype Co., 29 Ryerson St., Brooklyn, N. Y.

NON-OFFSET GUM—Portable gum delivers thin cushion of powder between printed sheets. Atomizes free-flowing liquid which dries while in air. May be installed on any type of press. Automatic control. American Type Founders Sales Corp., Elizabeth, N. J.

Safety Equipment

AUTOMATIC OVEN LIGHTER—"Pyratol." A safety device for automatically lighting gas-fired heaters and for protection agafnst pilot light failure. Can be incorporated with other controls. The Bristol Co., Waterbury, Conn.

Sanitation

PAPER TOWEL CABINET—"Turn-Towl." Paper towel and cabinet design to reduce towel waste. User must first push lever at left of cabinet, then turn crank at right, and finally tear off towel. Bay West Paper Co., Green Bay, Wis.

Textile

CLOTH DOUBLING MACHINE—GA doubling and folding machine. Goods can be doubled and reeled from rolls, tubes, or in flat fold, and can be examined and measured during the operation. Hermas Machine Co., Hawthorne, N. J.

COUNTER—Resetting pick counter. Principal unit is 2-shift counter. Additional unit may be added later to make complete 3-shift counter. Veeder-Root, Inc., Hartford, Conn.

HOSIERY MACHINE—Two models of single-head, full-fashioned hosiery machines. Model TL knits stocking blanks which require looping of the heel tabs to the sole. Model TC produces blanks with sides of the heel tabs attached to the sole. Wildman Mfg. Co., Norristown, Pa.

RAYON SLASHER—Rayon warps can be run at speeds of 80-100 yd. per min., it is claimed. Amount of stretch can be varied 2-15 per cent. Three dry cans used for progressive drying. Temperatures of the cans and the size are controlled. Saco-Lowell Shops, 147 Milk St., Boston.

SPINNING-ROLL COVERING—"Everlastic." For cotton and wool mills. Oilproof, non-oxidizing, unaffected by temperature changes. Synthetic-rubber compound is its base. Roger W. Cutler, 141 Milk St., Boston.

STOP-MOTION DEVICE—For circular knitting machines. Consists of electrified spider and electrified lower ring, both operated from a 12-volt transformer. Spider will stop machine for either a tight or a loose yarn. Crawford Mfg. Co., Inc., New Brunswick, N. J.

SUEDING MACHINE—Produces nap or pile on fabrics woven or knitted of continuous-filament rayon or silk. Wool, cotton, or linen can also be handled. "Seide Sueding Machine." R. L. Sjostrom & Co., Post office Sq., Boston.

Tools and Supplies

ALCOHOL TORCH—No. 30 self-blowing alcohol torch is said to produce small pointed flame of great heat intensity. Operates when turned sideways or upside down. Otto Bernz Co., Inc., Rochester, N. Y.

CUTTING ALLOY—"Crobalt." A cutting alloy available in bulk and in the form of cutting tools. Can be melted in electric furnaces at temperatures of around 3,000 deg. F. Tools have good free-cutting properties. Michigan Tool Co., Detroit.

EXPANSION BOLT—Expansion bolt which, it is claimed, will hold up to the breaking point of the bolt. Bolt is of steel; lead is used as anchorage material. "Life Time Bolt." Chicago Expansion Bolt Co., Room 633, 126 South Clinton St., Chicago.

FISH TAPE REEL—"Ideal Fish Tape Reel" for electrical wiring. Keeps tape coiled and protected. Tape is kept under constant tension. Two sizes. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore,, Ill.

GEAR PULLER—"Mayo No. 3-A." Central screw threads through collar to which hooks can be attached. Can be used with two or three pulling hooks. Handles gears up to 10 in. in diameter. Springfield Wheel Puller Co., Springfield, Ohio.

LAMP BASE EXTRACTOR—For removing the brass shell of broken electric lamps from the socket. Reverse-acting jaws. Handles insulated with pliable rubber. Length 6½ in. No. 107. William Schollhorn Co., New Haven, Conn.

PACKING—"Super-Seal." An all-service packing with dry-graphite lubrication. Available in six styles for special services. Put up in six forms. Crane Packing Co., 1800 Cuyler Ave., Chicago.

SOCKET SET—No. D3. Set of 16 sockets with double-hexagon openings ranging from ⅛ to 1½ in. for ½-in. square drive. Made of chrome-vanadium steel. Bonney Forge and Tool Works, Allentown, Pa.

SOLDERING POT—Small electric pot of 14-oz. capacity for dip-soldering of small parts. Melts pot of cold solder in 10 minutes. Vulcan Electric Co., Broad St., Lynn, Mass.

STEEL WOOL HOLDER—No. 17. Wool is inserted by bending up sides of holder, then clamping in wool. Made of rubber. Landon P. Smith, Inc., Irvington, N. J.

TAPE—"Electape." A pliable woven tape, coated with bakelite of high resistance. Said to be water and moistureproof. Revolite Corp., New Brunswick, N. J.

TOOL BITS—Line of standard size tool bits ground all over. Ends are ground deeply at compound angles. Heat treated and tempered. In both cobalt and super high-speed steel. Equipment Co., East Vernor Highway, Detroit.

VISE—No. 1115 steamfitters vise for heavy pipe work. Will take pipe from ⅛ to 6 in. Rear jaw moves so that long lengths of pipe can rest upon the bench. Athol Machine & Foundry Co., Athol, Mass.

WRENCH SOCKETS—Three new sizes of 1-in. Square Drive Extra Heavy Duty Sockets. For bolt sizes of 1½, 1⅞, and 2 in. Bonney Forge and Tool Works, Allentown, Pa.

Welding and Cutting

ACETYLENE GENERATOR—"Carbic CLP-4" portable acetylene generator. Consists of open-top tank into which is telescoped an enlarged section of an inverted cylinder which projects above the tank. Inside this cylinder is second cylinder holding calcium carbide briquettes. Capacity, 45 cu. ft. of gas per hr. Linde Air Products Co., 30 East 42d St., New York.

BRAZING ALLOY—"Phos-Copper," an alloy of phosphorous and copper. Melts at 707 deg. C. Has high tensile strength and good penetration. Especially suitable for applications where leak-proof joints are necessary. Westinghouse Electric & Mfg. Co., East Pittsburgh.

ELECTRODE—"Thinweld." Coated electrode for arc welding light-gage sheet metal. Three sizes: 1/16, 3/32, and ⅛ in. Said to have been used on metal as light as 24 gage. Hobart Bros., Hobart Sq., Troy, Ohio.

FLUX—"Nemco Flux" for use in welding cast iron with bronze or cast iron rods. Said to be quick acting. Northeast Metals Co., Torresdale Ave., Philadelphia.

GENERATOR—Mechanical control of welding current obtained through control of armature reaction fluxes. Units of 200, 300, and 400 amp. give currents from 60 to 500 amp. Drip-proof shell. Westinghouse Electric & Mfg. Co., East Pittsburgh.

WELDER—A.c. arc welder of transformer type. Has 15 heat stages, current range of 30–175 amp. Takes electrodes up to 5/32 in. in size. Voltage, 220. Mounted on casters. Marquette Mfg. Co., Inc., Minneapolis.

WELDER—For spot welding sample and pattern work and odd jobs. Aircooled, it can be adjusted for light or heavy duty work. Operated by foot pedal. Working head mounted on steel cabinet. Glascock Bros. Mfg. Co., West 5th St., Muncie, Ind.

WELDER—"SA-150" motor-driven, single-operator arc welder for general fabrication and repair work. Rated current range 45–200 amp. Has Class B insulation. Has 7½-hp. a.c. motor operating on 60-cycle circuits of 220 or 440 volts, 3 or 2 phases. The Lincoln Electric Co., Cleveland.

WELDERS—Portable and stationary arc welding units. Three sizes: 40–200 amp., 50–300 amp., and 75–400 amp. in models having 11- and 21-point controls. Eisler Engineering Co., Inc., South 13th St., Newark, N. J.

Wire and Wiring Devices

CONNECTORS—Parallel clamp connectors for connecting small tap-off wires to large conductors. Small groove takes No. 6, 0, and 2 solid or stranded tap-off wires. Large groove takes No. 4/0-250,000 circ.mil in one size, 300,000-350,000 circ.mil in other. W. N. Mathews Corp., St. Louis.

INSULATING MATERIAL—"Thinwol." High dielectric and tensile strength. For use on circuits employing voltage up to 220 a.c. or 450 d.c. General Electric Co., Schenectady, N. Y.

LUG—Solderless. One-piece design requiring no special wrenches and no separation of wire strands. For wire sizes from No. 8 stranded or No. 7 solid up to 500,000 circ.mil. H. B. Sherman Mfg. Co., Battle Creek, Mich.

PLUGS—Six-pole, multiple-circuit plugs and receptacles. Have positive locking arrangement. Rated at 10 amp., 250 volts. Pyle-National Co., 1334 North Kostner Ave., Chicago.

SOCKETS—Line of key sockets in which porcelain body extends through shell to form insulated support for key shaft. Arrow-Hart & Hegeman Electric Co., Hartford, Conn.

Change of Name

The Chain Products Co., Cleveland, Ohio. manufacturers of "Hodell Chains," have changed their name to The Hodell Chain Co.

Merger

Unyte Corp., New York, manufacturer of urea plastics, has been merged with Plaskon Co., Inc., Toledo, Ohio. Head offices will be in Toledo, and for the present, Unyte will be manufactured and sold under its own name.

•

TRADE LITERATURE

Air Conditioning—Bulletin K, a condensed catalog of line of air conditioning products. —Julien P. Friez & Sons, Inc., Baltimore.

Asbestos Products — Catalog, describing line of asbestos and magnesia products.—Keasbey & Mattison Co., Ambler, Pa.

Bearings—Catalog, on line of pillow blocks and ball bearings.—Ahlberg Bearing Co., 317 East 29th St., Chicago.

Belting—Booklet, title "Research, Illustrated," dealing with manufacture, application, and care of leather transmission belting and packings.—E. F. Houghton & Co., 240 West Somerset St., Philadelphia.

Blowers—Bulletin 21-B18, on application of blowers in ice plant service.—Roots-Connersville Blower Corp., Connersville, Ind.

Boiler Regulator—Form No. 401, describing regulator for boiler water level.—Northern Equipment Co., Erie, Pa.

Boilers—Bulletin No. 52B, on electric-heated steam generators for producing small quantities of steam.—Commonwealth Electric and Mfg. Co., 83-105 Boston St., Boston.

Bolts and Nuts—Catalog and price list, on line of bolts, nuts, screws, and washers. —The H. M. Harper Co., 2620 Fletcher St., Chicago.

Capacitors—Folder, describing savings made with Pyranol capacitors.—General Electric Co., Schenectady, N. Y.

Carbon Dioxide Meter—Data Book No. 403, describing line of carbon dioxide meters.—Republic Flow Meters Co., 2240 Diversey Parkway, Chicago.

Chain Drives—Catalog 636, on silent chain drives.—Ramsey Chain Co., Inc., Albany, N. Y.

Compressors—Bulletin L-620-B16, on types V3-A2 and V6-A2 aircooled, vertical, 2-stage compressors. — Worthington Pump and Machinery Corp., Harrison, N. J.

Compressors—Two bulletins: L-611-B11, on types HB-2 and HS-2 single tandem horizontal 2-stage compressors; L-611-B12, on types HB-3 and HS-3 single horizontal 3-stage compressors. — Worthington Pump and Machinery Corp., Harrison, N. J.

Condensers—Bulletin No. 3025, on Type ECC evaporative condensers.—Buffalo Forge Co., Buffalo.

Controller—Bulletin No. 447, on Model 6088V cycle controller.—The Bristol Co., Waterbury, Conn.

Controllers—Bulletin, on line of liquid level controllers and valves.—The McAlear Mfg. Co., 1901-09 South Western Ave., Chicago.

Controllers—Folder, on Air-o-Line air-operated controllers.—The Brown Instrument Co., Wayne and Roberts Aves., Philadelphia.

Conveyor Chain—Book No. 1552, on "RC" Silverlink conveyor chains.—Link-Belt Co., 519 North Holmes Ave., Indianapolis.

Counters—Bulletin 16, on type EC electric counters.—Production Instrument Co., 1325 South Wabash Ave., Chicago.

Crane—Bulletin No. 300, describing features of Tiger electric traveling crane.—Whiting Corp., Harvey, Ill.

Current Transformer—Bulletin No. 636, on Universal current transformer.—The Esterline-Angus Co., Indianapolis.

Cutting Machine—Folder, announcing flame cutting machine.—Schoitz Tool, Gear & Machine Works, Waterloo, Iowa.

Dial Indicators—Folder, on line of dial indicators for all kinds of physical measurements.—Federal Products Corp., 1144 Eddy St., Providence, R. I.

Diesel Engines—Bulletin S-500-B22, on type BB, direct-injection, vertical, 4-cycle diesel engines.—Worthington Pump and Machinery Corp., Harrison, N. J.

Dipping Baskets—Folder, on line of dipping baskets.—The C. O. Jelliff Mfg. Corp., Southport, Conn.

Doors—Folder 373, describing Bur-Vett vertical-lift steel doors.—Bethlehem Steel Co., Bethlehem, Pa.

Drill—Folder, on "The Midget" No. 801 CP universal electric drill.—Chicago Pneumatic Tool Co., 6 East 44th St., New York.

Electric Heating Systems—Bulletin No. 10, on electric heating systems with automatic control.—Hynes Electric Heating Co., 240 Cherry St., Philadelphia.

Elevators—Folder, announcing finger-tip control for all types of elevators.—Otis Elevator Co., 260 Eleventh Ave., New York.

Enamels—Four folders, on four different enamels for metals.—Roxalin Flexible Lacquer Co., Elizabeth, N. J.

Engineering Services — Booklet, title "Speaking From Experience," telling of various services rendered.—Mid-States Industrial Corp., 2401 Eleventh St., Rockford, Ill.

Exhaust Fans—Bulletin No. 1002-2, describing Norblo slow-speed exhaust fans.—The Northern Blower Co., West 65th St., Cleveland.

Fans—Two catalogs: one on air circulators, one on ceiling fans.—The Emerson Electric Mfg. Co., St. Louis.

Fans and Blowers—Catalog No. FB-45, on line of propeller fans and blowers.—Ilg Electric Ventilating Co., 2850 North Crawford Ave., Chicago.

Fire Pumps—Bulletin W-112-B4, on type DF, horizontal duplex, direct-acting fire pumps.—Worthington Pump and Machinery Corp., Harrison, N. J.

Fish Tape Reel—Folder, announcing fish tape reel for wiring.—Ideal Commutator Dresser Co., Sycamore, Ill.

Flow Meter—Bulletin, describing Fast-Flo Xacto Meter.—S. F. Bowser & Co., Inc., Fort Wayne, Ind.

Flow Meters—Bulletin 2096, on electric flow meters.—Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia.

Fuel Oil Heater—Folder 707, describing Twin G-Fin Section fuel oil heater.—The Griscom-Russell Co., 285 Madison Ave., New York.

Furnace—Folder, on Braze-Rite electric furnace.—Firth-Sterling Steel Co., McKeesport, Pa.

Gas Engines—Bulletin S-550-B4B, on type AG vertical, 4-cycle gas engines.—Worthington Pump and Machinery Corp., Harrison, N. J.

Grinding — Reprint, title "Grinding in Chrysler Production."—Norton Co., Worcester, Mass.

Hoists—Catalog, showing hoisting equipment.—The Yale & Towne Mfg. Co., 4530 Tacony St., Philadelphia.

Hone—Folder, announcing precision hone. —Sunnen Products Co., 7900 Manchester Ave., St. Louis.

Instruments—Case 12 of "Solving Industrial Crimes" series.—The Esterline-Angus Co., Indianapolis.

Insulation—Revised edition of "Barriers to Industrial Waste."—Johns-Manville, 22 East 40th St., New York.

Inventory Control—Folder, describing perpetual inventory control system. — The McCaskey Register Co., Alliance, Ohio.

Lathe—Bulletin S-10, describing hydraulic multi-speed lathe.—The Monarch Machine Tool Co., Sidney, Ohio.

Lifters—Circular No. 320, on mechanical lifters for materials handling.—Lewis-Shepard Co., 253 Walnut St., Watertown, Mass.

Lighting—Catalog, called "Datalog," on complete line of lighting equipment.—Holophane Co., Inc., 342 Madison Ave., New York.

Lubricants—Folder, on Lubriplate fluid and grease lubricating compounds.—Fiske Brothers Refining Co., 24 State St., New York.

Magnet Steel—Folder, describing Nipermag permanent magnet alloy.—Cinaudagraph Corp., Stamford, Conn.

Manganese Steel—Folder, title "The Story of Manganese Steel."—American Manganese Steel Co., Chicago Heights, Ill.

Measuring Bridge—Leaflet, describing the Z measuring bridge for a.c. and d.c.—Herman H. Sticht & Co., 27 Park Place, New York.

Melting Pots—Leaflet TD-11, showing electric melting pots.—Harold E. Trent Co., 618-640 North 54th St., Philadelphia.

Metal—Catalog No. 21, describing Ampco metal, a bronze.—Ampco Metal, Inc., 3830 West Burnham St., Milwaukee.

Mill Drive—Folder, describing new mill drive.—The Patterson Foundry & Machine Co., East Liverpool, Ohio.

Motors—Bulletin GEA-1974, on type K squirrel-cage induction motors.—General Electric Co., Schenectady, N. Y.

Motors—Folder, on application, selection, and installation of totally inclosed, fan-cooled motors.—The Lincoln Electric Co., Cleveland.

Nut—Form 4186, describing Quick-Lok nut. —The Philip Carey Co., 410 North Michigan Ave., Chicago.

Packing — Folder, describing Super-Seal plastic packing.—Crane Packing Co., 1800 Cuyler Ave., Chicago.

Paint—Catalog and reference book on paint and paint supplies.—Morris Paint & Varnish Co., 5161 Easton Ave., St. Louis.

Photomicrography—Catalog E-21, on photomicrographic equipment.—Bausch & Lomb Optical Co., Rochester, N. Y.

Plywood Bonding Material—Booklet, on Tego-Bonded Construction using Tego Glue Film.—The Resinous Products & Chemical Co., Inc., 222 West Washington Sq., Philadelphia.

Power Conference—Tours bulletin, on the Third World Power Conference.—The Director, Third World Power Conference, Interior Bldg., Washington, D. C.

Press—Bulletin 59-C, on No. 101 bench-type power press.—Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y.

Presses—Bulletin 405, describing inclinable stamping presses.—Niagara Machine and Tool Works, Buffalo, N. Y.

Presses—Two bulletins: No. 126, on general utility hydraulic presses; No. 127, on "Hyspeed" presses. — Baldwin-Southwark Corp., Philadelphia.

Pumps—Bulletin 161, on non-clogging centrifugal pumps.—Morris Machine Works, Baldwinsville, N. Y.

Pyrometer—Bulletin 194-1, describing Stabilog potentiometer-control pyrometer.—The Foxboro Co., Foxboro, Mass.

Pyrometers—Catalog 1101B, on line of pyrometers with high speed photoelectric action.—C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y.

Pyrometers—Catalog N-33A, describing Micromax Thermocouple Pyrometers.—Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia.

Ram—Leaflet, announcing additions to the Porto-Power line of portable hydraulic rams.—Blackhawk Mfg. Co., Milwaukee.

(Continued on page 92)

Trucks illustrated made by the following companies:

1. Terminal Engineering Co.
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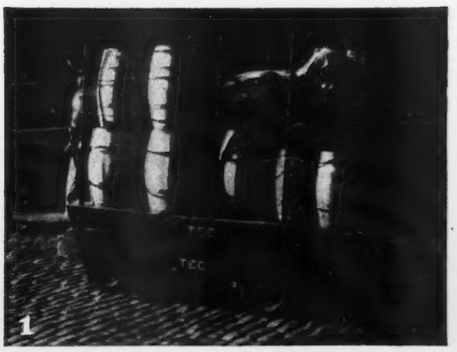

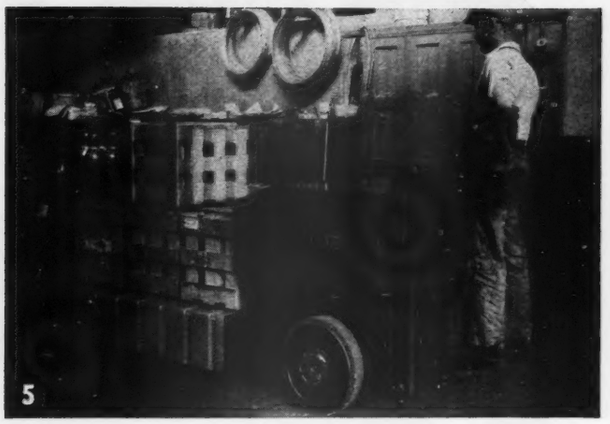

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Questions and Answers

(Continued from page 62)

strike to gird for battle instead of for bargaining.

There are unconscionable rackets in the labor field as there are in manufacturing. Do not conclude, however, that the organizers for your employees are operating a racket until you have given them time, and encouragement by a reasonable attitude, to cool off. Find out whether you or your representatives have made your workers hire counsel to get the treatment they think they are entitled to.—EDITOR.

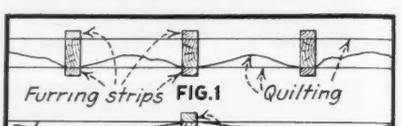
Isolating a Noisy Department

In one section of our plant a considerable amount of grinding is done, and automatic hammers are used for certain operations. Of course, it is very noisy and we are considering partitioning this section from the remainder of the shop. We should like to know what would be the best materials or kind of construction to use, in order to confine as much of the noise as possible in this department. —*A.M.*

SO-CALLED quilt insulation, really a matting felted from plant fibers, can be used in constructing a partition that will effectively restrict the passage of sound. For good results use at least three thicknesses of quilt.

A construction that is claimed to reduce noise transmission by more than 90 per cent is shown in Figure 1, which indicates a plan view of a wall with three thicknesses applied. The first thickness is draped in loosely, and tacked lightly to the studs on one side. Over each side of the studs another layer of the quilt is applied relatively tightly. Furring strips are then nailed to the studding to hold the quilt in place and provide a base for lath or wallboard.

A construction that is more effective and makes use of the staggered-stud principle is shown in Figure 2. This construction really produces a double wall, since there are no through studs that can convey sound; there is always a dead air space between. Studding is set in two courses, staggered. Thus the lath and plaster, say, on one side



of the wall will be applied to one half of the studs only, whereas on the other side they will be applied to the other studs.

Two layers of quilt are applied and tacked lightly to all studs; then two other layers are applied, relatively tightly, to each separate stud course. Furring strips are applied, as shown. Such a partition is very effective in reducing the transmission of sound.

JOHN E. HYLER, *Peoria, Ill.*

ONE OF the best and cheapest noise-insulating materials that I know of is a prepared material that is honey-combed with small holes. It comes in blocks a foot square.

If the department referred to is isolated by a wooden partition insulated with this material, and the ceiling and walls inside are covered with it, the noise will be reduced very markedly.

We have installed this material in our main office with very good results.

WM. C. BETZ, *Equipment Engineer*
The Fafnir Bearing Company
New Britain, Conn.

How Determine Watts Loss in a Circuit?

I wish that readers would give me some information on the best methods of determining the power loss in some of our motor circuits. For example, on a three-phase, three-wire, 440-volt, 60-cycle circuit feeding about 400 induction motors ranging from 1 to 5 hp., these readings were taken, at the source: Kilowatts, 164; voltage between phases, 457; amperes, one

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phase, 365; resistance, 0.96 ohms. This figure was obtained by multiplying the single-phase resistance by 3. Can the power loss in watts in this circuit be calculated from these figures? If not, what is the best method of determining such losses? —S.S.

METHODS of calculating the power loss in this circuit can conveniently be shown as follows:

Kva. $= (E \times I \times \sqrt{3} \div 1000 = (457 \times 365 \times 1.732) \div 1{,}000 = 289$, where

E = volts per phase
I = amp. per phase
$\sqrt{3} = 1.732$.

Power factor of the circuit = Kw. ÷ kva. = 164 ÷ 289 = 56.75 per cent, lagging.

Three-phase impedance, Z, = $E \div I = 457 \div 365 = 1.252$ ohms

Three-phase reactance, X, = 1.032 ohms

Three-phase resistance, R, = 0.711 ohms

Impedance drop, per cent, = [(1.252 × 365) ÷ 457] × 100 = 100

Reactance drop, per cent, = [(1.032 × 365) ÷ 457] × 100 = 82.42

Resistance drop, per cent, = [(0.711 × 365) ÷ 457] × 100 = 56.75

When the equivalent three-phase resistance in ohms and the current are known power loss in a three-phase circuit can be calculated as follows:

I^2R loss = $365^2 \times 0.711 = 94{,}730$ watts, or 94.73 kw.

Per cent loss = (94.73 ÷ 164) × 100 = 57.8

The power loss of 94.73 kw. represents the total loss in the circuit, including losses in the cables. Power losses in the cables can be calculated only when the resistance of the cables alone is known.

From the data given in the question it is impossible to calculate the I^2R or power losses in the cables themselves, without knowing the resistance in ohms. A resistance value of 0.96 ohms is given, but it is not stated whether this value represents the resistance of the cable or the total resistance of the load and cable. Based on the readings taken at the source, a total resistance of 0.711 ohms, as previously mentioned, can be calculated.

I do not believe that 0.96 ohms represents the resistance of the cables themselves, since this would give an unusually large power loss as well as resistance drop in the conductors. The question indicates that the value of 0.96 ohms was obtained by multiplying the single-phase resistance by 3. Dividing 3 into 0.96 gives a value of 0.32 ohms as representing the single-phase resistance. The equivalent three-phase resistance would then become 0.55 ohms instead of 0.96 ohms as given, because the three-phase resistance is equivalent to the single-phase resistance times the square root of 3, instead of the single-phase resistance multiplied by 3.

Assuming that the three-phase resistance of the cables is 0.55 ohms the total power loss in the conductors would be: $365^2 \times 0.55 = 73{,}250$ watts, or 73.25 kw.

The resistance drop would be: 365 × 0.55 = 201 volts IR drop.

These values appear to be unreasonable for a 440-volt circuit since the power loss in the conductors would be 44.6 per cent of the total load in the circuit.

As an example of the determination of power losses in cables, consider the following:

Size of cable = 600,000 circ.mil per phase

Distance, one way, = 400 ft.

Resistance = 0.01751 ohms per 1,000 ft. at 75 deg. F.

Amp. per phase = 365

Resistance of each cable = 0.01751 × 0.4 = 0.007 ohms

Three-phase resistance = 0.007 × 1.732 = 0.01212 ohms

I^2R loss = $365^2 \times 0.01212 = 1{,}614$ watts, or 1.614 kw.

It will be easy for S.S. to determine the power loss in the cables by first ascertaining the size and then referring to a wire table showing their resistance.

It is apparent from the calculations that the power factor of this circuit is rather low. Therefore, it is suggested that the economics of power factor cor-

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SURE, you can use strong backs to tote heavy hunks of steel around your plant. And for that matter, old hand-operated equipment will still lick the law of gravity. But for the speed and economy that will cut your material handling costs, look to 1936 methods.

P&H engineers have experience with hundreds of different handling problems in all kinds of plants. They have the answers that save you money. That's why up-and-coming production men call in a P&H engineer occasionally . . . to see what's new in material handling methods and equipment. If any P&H engineer can't show you how to cut your costs, he'll frankly tell you so. There's no obligation. Why not ask one to call? Or write for Bulletin RH-2.

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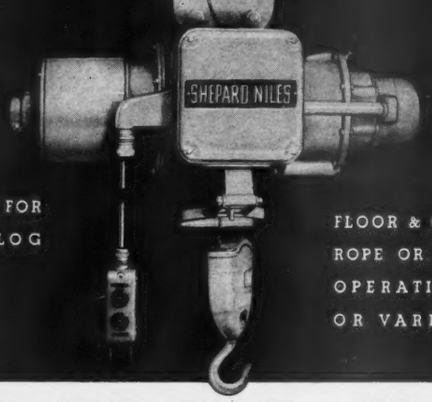

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rection be investigated. A considerable saving could be effected by raising the power factor from 56.75 to at least 80 per cent, or whatever value is specified in the power factor clause in the contract.

W. G. McDONALD

Steel Mill Section, Industrial Division, Westinghouse Electric & Mfg. Co., Philadelphia

Cross-Connections on Small Armatures

I wish some reader would tell me what advantages are gained by cross-connecting the armatures used in ¼-, ⅓-, and ½-hp. motors for such applications as refrigerators. Will leaving these connections off when rewinding cause any serious trouble? What is the quickest and simplest way of testing such armatures for shorts and other defects?

—F.E.H.

CROSS-CONNECTIONS or equalizers are used to bring diametrically opposite points in the winding to the same potential. With a lap-wound armature using four brushes, only two brushes are needed when equalizers are used.

It will be seen that if cross-connections are left off this type of winding, the current distribution in the coils becomes unequal, and the motor will not operate satisfactorily.

These equalizers also tend to prevent circulating currents between brushes. If the bearings become worn the smaller air gap will cause greater flux densities in some groups of coils than in others. Higher voltages will be generated in these coils, causing currents to circulate between different groups of brushes, if there are no equalizers to prevent it. Hence, in rewinding such armatures it is advisable to put in the equalizers.

A growler or regular testing outfit will be found satisfactory for testing such armatures.

CLARENCE W. HOPE, *Waltham, Mass.*

ARMATURES of small motors such as referred to are either wave- or lap-wound and are similar, except for the cross-connection jumpers on the latter type, to the windings on the armatures of small d.c. motors.

One reason for cross-connecting the diametrically opposite commutator bars of lap-wound armatures, connecting points of the winding theoretically at the same potential, is to eliminate all except one pair of brushes and brushholders. For example, a four-pole, lap-wound armature requires four brushes, one per pole, unless the commutator is cross-connected. The motor would probably fail to operate, or the armature would overheat, if the jumpers were left off. On the other hand, if such armatures are rewound with a wave winding the cross-connections can be left off, and the motor will operate satisfactorily.

Another reason for using cross-connections on many motors of this type

is to equalize the voltage in all parts of the armature winding. If for any reason the flux density in the armature core is unequal under the field poles, unequal voltages will be generated in the different groups of armature coils. These unequal voltages will cause circulating currents between different brush groups, resulting in sparking and other bad effects.

A frequent cause of this condition is an armature that is improperly centered between the polepieces. Although the circulating currents can not be prevented from flowing in the winding, they can be partly prevented from flowing between the different groups of brushes by the use of cross-connections.

A quick and reliable method of testing such armatures is by a bar-to-bar test. A change in the instrument reading as different pairs of commutator bars are bridged indicates a fault in the coil connected to those bars.

Faulty or loose connections to the commutator bars are among the most frequent causes of trouble.

J. L. YOUNG, *St. Marys, Ohio*

Industry Must Make More of Everything

(Continued from page 39)

ing power that is needed for a general prosperity.

"Industry is accused of doing a good deal of harm by using machines, wherever it can, to reduce costs. The people who worry most about what they call labor-saving machinery overlook the point that it is not labor-saving, but labor-shifting. When a manufacturer replaces a line of hand-controlled machines by installing one automatic machine, he has given employment—back in the machine-tool maker's plant—to a good many highly skilled men and has thus permitted employment at higher wages than he could possibly pay for running a simple lathe or drill or miller. In our own shops we have been demonstrating that for years. And by the saving in cost of his finished product, the manufacturer is able to pay better wages, reduce his costs, improve his plant, and get a living for all the families dependent on the work.

"It is easy for some people to think incorrectly about what should happen to the savings brought about by better production methods. The labor leader says, 'Give it to the workers.' The financial man says, 'Add it to profits.' The production man says, 'Use it to improve the plant and equipment.' The salesman says, 'Cut it off the price to the consumer.'

"Actually there should be a four-

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for A. G. Spalding & Bros.

Leaders in all fields of manufacture have standardized on DeVilbiss Spray-Finishing Equipment because of the beautiful, lasting finishes it produces. Better finishes impart greater selling appeal to the product, insuring a higher degree of customer satisfaction. Lower finishing costs are another reason why manufacturers have turned to DeVilbiss. They know from experience that less time and less labor are required to do a finishing job with DeVilbiss Spray-Finishing Equipment.

You too, may have the advantage of this proved quality and economy in your finishing operations. Investigate the new and modern developments in DeVilbiss Spray-Finishing and Exhaust Equipment.

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Direct sales and service representatives available everywhere

DeVilbiss

A half century of engineering progress . . . and

DIXON'S

FLAKE LUBRICATING GRAPHITE

Power plants of fifty years ago welcomed Dixon's Ticonderoga Flake Lubricating Graphite. It became indispensible for lubrication, for coating gaskets, packing and countless other uses. The qualities inherent in Dixon's Ticonderoga Flake Lubricating Graphite need no stronger endorsement than the fact that, with all the changes in power equipment, this fine old Dixon product still holds its place and the red can is as familiar to engineers today as it was a half century ago.

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way split of any saving that comes from better manufacturing. It should be used to raise wages, to reduce prices, to improve the plant, and to increase the reserve necessary to a continuing business. The way it works out in most soundly managed and steadily growing businesses is that the plant gets both its own and the owner's share, which can do no harm and may do a lot of good. But if it should all be given either to the workers or to the public, or even split between them, the plant would fall behind and eventually the business would be in trouble.

How Machines Make Jobs

"Another point which seems too simple to be easily understood is that modern machinery makes employment by bringing manufactured products down to a price within reach of the buying public. It seems obvious that the modern automobile industry—which certainly contributes greatly to our national prosperity—could never have been developed without the development of better machinery. Just where along the line should its adoption of more efficient machines have been halted? Whatever stage of development had been selected would have marked the end of its expansion and would have frozen employment at that year's figure for all time.

"Yesterday we placed in operation the largest industrial turbo-generator in the world. Someone asked how big that plant would have to be if power production were at the stage where it was when we started making automobiles. An engineer made a few quick calculations and said, 'The plant would have to be at least 5 miles long.'

"Our Rouge power plant Number One converts into power 75 carloads of coal per day. Its workers are almost without exception dressed in white overalls, and they look about as clean at the end of the shift as when they came to work. Imagine, if you can, how much more an automobile would have to cost if we had to shovel those 75 carloads of coal into boilers by hand, shovel out the ashes, tend the fires with slicebars and old-fashioned pokers! In fact, it would probably require twice or three times as much coal to generate the same amount of power, so greatly has the thermal efficiency been increased.

"The theorist says, 'Think how many more men would be employed if they used hand-fired boilers and old-time engines.' The production man realistically answers, 'Think how few men we could employ in our plants if we had to charge enough

Make Use of the Industrial Experience of
INTERNATIONAL HARVESTER
When There's a Power Problem to Be Solved

Two Model I-12 International Industrial Tractors working for North American Cyanamid, Ltd., at its Niagara Falls, Ont., Canada plant — the largest cyanamid plant in the world

●

The International Harvester line of industrial power includes wheel-type tractors, TracTracTors, stationary power units from 12 h. p. to more than 100 h. p. and 1½ to 5 h. p. engines for light-duty service.

● Before long the *Millionth* Tractor of International Harvester manufacture will be coming off the assembly lines and going out to handle somebody's power job. That's by long odds the biggest tractor-production figure in the industry. It is also a measure of our thirty-year experience in this field —experience which will be of value to you when you have a power problem to handle and need efficiency and economy on the job.

If your work calls for powerful crawler or wheel tractors, small tractors for cramped areas, fixed power units, small engines or motor trucks — call on a branch or authorized industrial dealer in the International Harvester sales-service organization.

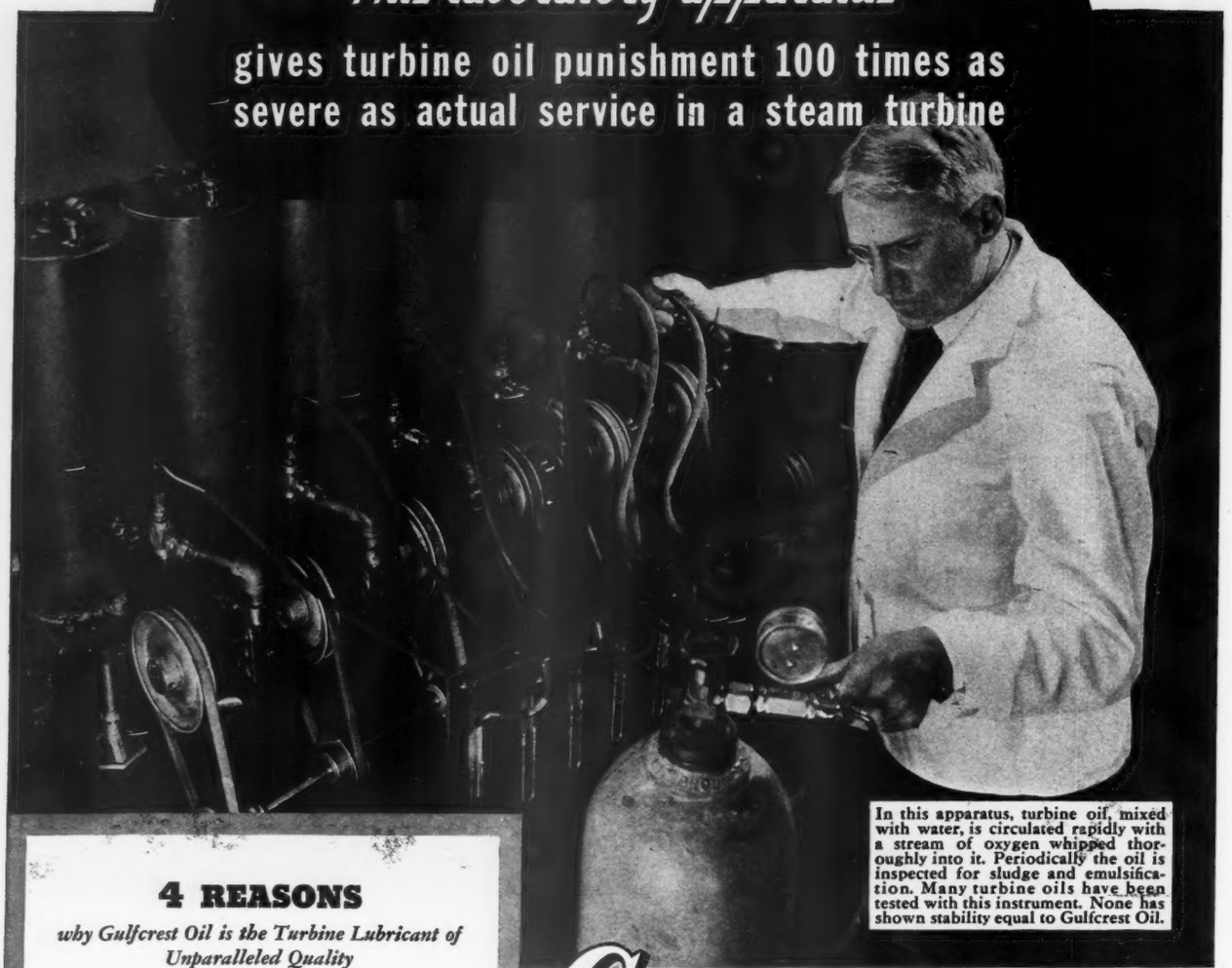
Vast numbers of successful installations of International Tractors, Power Units and Motor Trucks, all over the land, are your guarantee that this Company will give you the soundest, most profitable answer to your own power problem. Cash in on International *Experience.* Specific information will be sent by mail on request.

INTERNATIONAL HARVESTER COMPANY
(INCORPORATED)
606 So. Michigan Ave. Chicago, Illinois

INTERNATIONAL HARVESTER

This laboratory apparatus

gives turbine oil punishment 100 times as severe as actual service in a steam turbine



In this apparatus, turbine oil, mixed with water, is circulated rapidly with a stream of oxygen whipped thoroughly into it. Periodically the oil is inspected for sludge and emulsification. Many turbine oils have been tested with this instrument. None has shown stability equal to Gulfcrest Oil.

4 REASONS

why Gulfcrest Oil is the Turbine Lubricant of Unparalleled Quality

•

1 *Refined by the ALCHLOR Process.* This famous process, patented and owned exclusively by Gulf, is the most thorough and effective method for removing chemically active hydrocarbons as well as the general run of impurities present in all crudes.

2 *Highest resistance to oxidation.* Because this famous ALCHLOR Process synthesizes and rearranges the molecular structure of certain hydrocarbons, resulting in a finished product of greater stability, GULFCREST OIL stands alone in its high resistance to oxidation.

3 *Highest resistance to acidity and sludge.* Because of the elimination of oxidation catalysts in addition to the unparalleled refining power of the Alchlor Process, these oils form less gum and deposits, less emulsion and sludge, when mixed with water over a period of several years continuous operation, than any other turbine oil of which we have record.

4 *Highest kilowatt-hour performance.* Because Alchlor not only makes possible an oil more thoroughly refined and homogeneous but also creates anti-oxidants, these oils have great resistance to deteriorating influences and are longer lived. Less make-up oil is required.

GULFCREST OIL

proves greater stability

LABORATORY TESTS, like that shown above, are one way in which the greater stability of Gulfcrest Oil has been proved.

But still more impressive are the reports from plants where Gulfcrest has been in service for turbine lubrication. They definitely prove that Gulfcrest today is out-performing turbine oils which have been considered, in the past, the best obtainable.

Treatment by the ALCHLOR Process gives Gulfcrest Oil certain important characteristics which cannot be developed by any other refining method in use today. Let Gulfcrest demonstrate its value in your equipment.

GULF OIL CORPORATION—GULF REFINING COMPANY

General Offices: Gulf Building, Pittsburgh, Pa.

Makers of that Good Gulf Gasoline and Gulflube Motor Oil

for our automobiles to pay the cost of doing the work in so primitive a way. Think how few could afford an automobile under such conditions!'

"We need the 8-hour day in industry, and good wages for the 8 hours. Some day, we feel confident, the 6-hour day or even the 5-hour day will come. But not yet. It is too soon for that now. The proper adjustments have not been made. We do not know how to produce enough in 6 hours to give a man a full day's wage. When we know more about manufacturing, when we can produce enough real wealth—that is to say, *goods*—for everybody to reach the standard of living we all cherish, then we can begin reducing hours beyond the present work day. But we are not yet there.

Lower Prices, Higher Wages

"Before we can reach the shorter work day, we must learn to produce so that we can not only reduce prices but also raise wages. The two go hand in hand. When you lower prices you get more sales and then you can pay more wages. We restored our $6 minimum wage more than a year ago, just as soon as we felt it could safely be done. The only right wages are those that permit the worker to live well enough the year around to maintain his self-respect, to have enough income so that he can be a good consumer as well as a good producer. Trying to classify one person as solely a producer and the other as solely a consumer will not work. Those very few—very, very few—who live off the work of others and contribute no useful labor to the world may be only consumers, but everyone else also consumes, and the better he is as a producer the better he can be as a consumer. You cannot have production without consumption, nor the other way around. The two move forward practically abreast.

"The manufacturer who produces a good product at low prices and pays his workers good wages is not only doing his share in helping to pull our people out of the troubles caused by the financial madness of the twenties, but he is also carrying his share of a bigger load. He is pulling up our people's standards of living. As long as he continues along these lines, we need have no doubt that we shall see a higher standard of prosperity and more real wealth in the form of usable goods than we have known in the past. As manufacturers we must only make sure that we keep doing a better job, making better products, using better processes, paying higher wages. If industry should cease its progress, the forward march of prosperity would also have to stop. Working individually toward these goals, we cannot even forecast how much greater will be our people's wealth, how much better their living conditions, than anything the world has ever seen."

For Plant Replacement—Cash

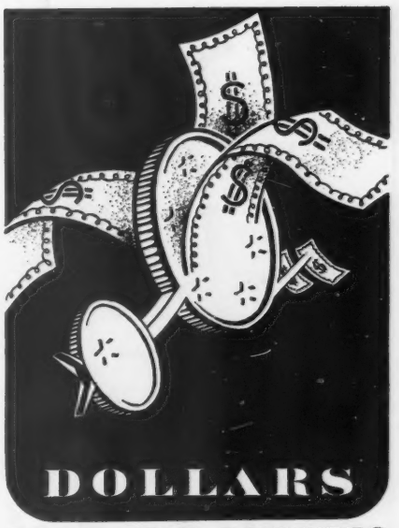
(Continued from page 42)

the form of cash in the bank and bonds, will aggregate $60,000 on December 31, 1940, having been built up by the 40 semi-annual contributions of $1,105.58 to $44,223.20, plus income in the amount of $15,776.80. Because the original factory will probably need replacement at that time, a new one will be erected with the cash in the bank account, plus the proceeds from sale of the bonds. If it develops that the cost of constructing a new factory will exceed the estimated amount for which provision has been made, the amount of the semi-annual contributions can be increased during the remaining years.

During the 20 years of life of the original factory, the annual net profit will have been reduced to the extent of the $3,000 of depreciation expense. Assuming gross profit before depreciation for the 20-year period to be $100,000, then net profit will amount to $40,000. Now the $60,000 of depreciation expense ($250 per month for 20 years) has not represented an outlay of cash each month. Therefore, if no disposal has been made of it, the full $100,000 of gross profit will be on hand either in the form of cash in bank or other assets.

Without the plant replacement fund, however, it is probable that a considerable portion would have been distributed to the shareholders in the form of dividends, and much might have been spent for betterments and improvements to the plant. As a result, at the close of the 20-year period the cash position would stand at the minimum amount necessary for carrying on normal business. In other words, there would not be sufficient cash available to defray the cost of erecting a new factory.

One important thing to keep in mind is that any bonds acquired for a plant replacement fund should be earmarked for that account. This is especially necessary in the event that other bonds are owned. An account,



RIDE THE BREEZES
when you clean the air

By purifying the air in your plant with a Coppus Air Filter (proved by dust count of filtered air to pass cleaner air than any other commercial filter), you can earn four distinct dividends on your investment.

1. EFFICIENCY AND HEALTH of your working force are increased when they breathe clean air—their production is stepped up.
2. PRODUCT QUALITY MAINTAINED—against any impurities, discoloration, etc., due to dust.
3. LABOR COSTS CUT, since equipment needs less frequent cleaning.
4. VALUABLE MATERIAL RECOVERED from the air, wherever dry products are processed.

Two types of Coppus Air Filters—

The *Dry-Matic*—the only automatically self-cleaning dry type filter. Bulletin F-350-1.

Unit Type—Bulletin F-320-3.

Both made to the efficiency called for by your particular needs—eliminating up to 99% 2 micron size dust depending on your needs.

Write for Bulletins.

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COPPUS
PASS CLEAN AIR
ENGINEERING CORPORATION
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In Sweet's—Steam Turbines, Air Filters
Blowers and Heat Killers

3325

"Any possible comparison would favor American Hand Trucks"

A statement like this pleases us—and *should interest any man who buys hand trucks.* It was made by the Philadelphia & Norfolk Steamship Company on the basis of actual experience with nearly 400 American Pressed Steel Hand Trucks. "The service on our piers is unusually severe," writes this user of "American" trucks. "We transport freight of almost every character, and we use our trucks for all sorts of purposes. Although these trucks are light in weight, well-balanced and easy running, they stand up well under the most severe conditions of service and we assure you that any possible comparison either of maintenance costs or length of truck life would be greatly in favor of 'Americans'."

There is an American Hand Truck to meet *your* particular material handling needs. The sooner you standardize on it—the greater your savings. Write today for the American Hand Truck Catalog and make *your* selection.

THE AMERICAN PULLEY COMPANY
4200 Wissahickon Ave., Philadelphia, Pa.

The labor saving, floor saving, rubber-tired, roller-bearing "American" hand truck wheel.

AMERICAN
PRESSED STEEL
HAND TRUCKS

separate from that for other bonds, should be maintained on the books for the bonds of the plant replacement fund.

Criticism may be leveled at this accounting policy on the grounds that cash is tied up in an ever-increasing amount. The amounts periodically set aside are small enough, however, to be no detriment to normal operations. In any case, the fund built up is always at the disposal of the board of directors. Should an emergency arise, there is nothing to prevent re-appropriation of a portion or all of the fund. To use the cash that way, though, and not return it, is to wreck replacement plans.

Large organizations with carefully developed budgetary control systems and assets readily convertible to cash may frown on this plan. For them it may be unnecessary, provided their control is right enough and they are willing to raise necessary cash over a short period of time. But the average concern is playing a whole lot safer if it makes plans insuring its having the necessary cash when replacements become imperative.

If Brushes Could Talk

(Continued from page 50)

rings were burned more than the third. It was at first assumed that the brush tension should be heavier on account of the vibration present. Then a more careful investigation disclosed a short circuit between two adjacent sets of resistance coils in the rotor circuit of the starter.

Another instance of trouble with a slipring motor proved to be a little more puzzling. The motor refused to start, although it growled a good deal and took considerable current, but not enough to blow the fuses. The brushes, of which there were two per stud, were lifted but seemed to be making good contact all over, although they were somewhat overheated on two of the ring brush stud sets.

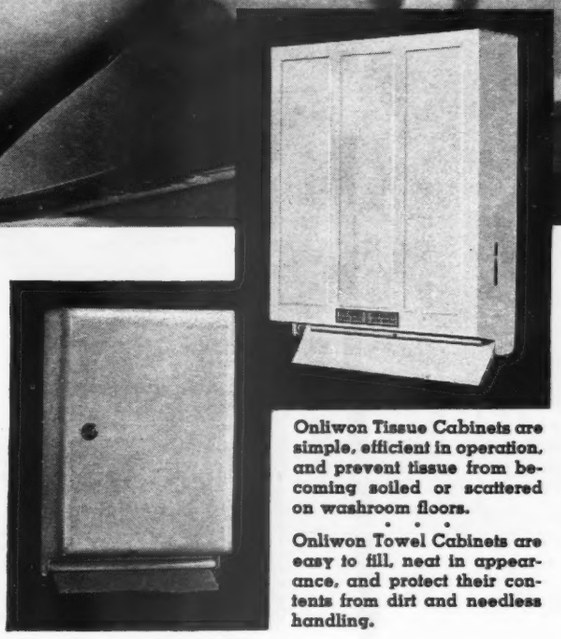
At length, as an emergency measure, the three brush studs were temporarily shorted by twisting strands of wire around them and making the machine into practically a squirrel-cage type. It then started up, although it took a heavy current and did not develop full power.

Up to this point the trouble had been assumed to be a broken star point connection or a broken or

Wanted RIGHT NOW.. *a good Towel*

HERE'S a man who needs a thorough drying job *right now,* and wants a good towel. Multiply him by the number of employés in your organization. Multiply this by the number of times each of them washes every day. That will give you a good idea of how many times every day towels can *cost you money*—if they aren't up to their job in every respect.

If you're not already using Onliwon Towels, it will pay you to install them in every one of your washrooms. For one thing, people *like* them. They're soft and pleasant to use—do their job well and protect employés' health. And, because a single Onliwon Towel will usually do the work of several ordinary ones, you'll find, as thousands of others have, that there's real economy in these man-sized, properly made towels. The Onliwon Cabinet is a big help on the score of economy, too. Dispenses only one towel at a time, keeps another always ready for instant use. Easy to fill—and keep filled—fool-proof, and a definite protection against theft and waste.



Onliwon Tissue Cabinets are simple, efficient in operation, and prevent tissue from becoming soiled or scattered on washroom floors.

• • •

Onliwon Towel Cabinets are easy to fill, neat in appearance, and protect their contents from dirt and needless handling.

Phone your local A. P. W. representative today—ask him to show you how Onliwon Towels (and Onliwon Tissue as well) can improve your washroom service—and bring real economy at the same time.

Or, write for sample to: A. P. W. Paper Company, Albany, N. Y.

A.P.W.

THERE'S REAL SAVING IN ONLIWON TOWELS AND TISSUE

THE WORLD'S LARGEST BAKERY
ENDORSES
YALE TRUCKS-YALE SERVICE

IT takes keen judges of value to be the world's largest consumer-purchasers of flour, sugar, butter, eggs and other baking items. The accompanying letter explains why Yale Hand Lift Trucks and Skid Platforms stand the test of these discriminating buyers.

NATIONAL BISCUIT COMPANY
449 West Fourteenth Street, New York

July
Ninth
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The Yale & Towne Mfg. Co.,
4530 Tacony Street,
Philadelphia, Pa.

Gentlemen:

The service rendered by your engineers in adapting equipment to meet our individual needs has been highly important in our business relations.

For example, a special trailer hook was designed by the Yale & Towne engineers to give us better results in hauling multiple lift truck loads. A difficult ramp condition was overcome through adjustment of truck wheel base length. Countersunk bolts on the skids were installed to prevent humps forming in carton lining paper, that could later cause breakage in machines.

We are particular about little things that make for perfection in our finished goods and appreciative of the same spirit on the part of manufacturers whose equipment we use.

Very truly yours,
NATIONAL BISCUIT COMPANY

-YALE-

THE YALE & TOWNE MFG. CO.
Philadelphia Division Philadelphia, Pa., U. S. A.

partly shorted phase winding, but the real cause was eventually found to be that the two brushes on one stud had loose pigtails. This condition did not show up when the brushes were lifted because they were firm enough under a direct pull. But they were found to be so loose in their attachments to the brushes that they could be twisted around in the holes. The excessive loss of capacity at full speed was, of course, due to the fact that the rotor voltage was then much lower than at starting.

Pigtail connections should always be of the most substantial kind, both mechanically and electrically, and should be examined periodically.

Testing Different Brushes

In order to keep the commutator of a d.c. motor reasonably free from dirt, it was decided to use brushes of a grade that had a somewhat higher degree of abrasiveness than those supplied with the machine. The change had in fact been suggested by the manufacturers. So far so good, but in order to test the relative advantages of the old and the new grades, new brushes were put in one half of each stud and the old brushes in the other half.

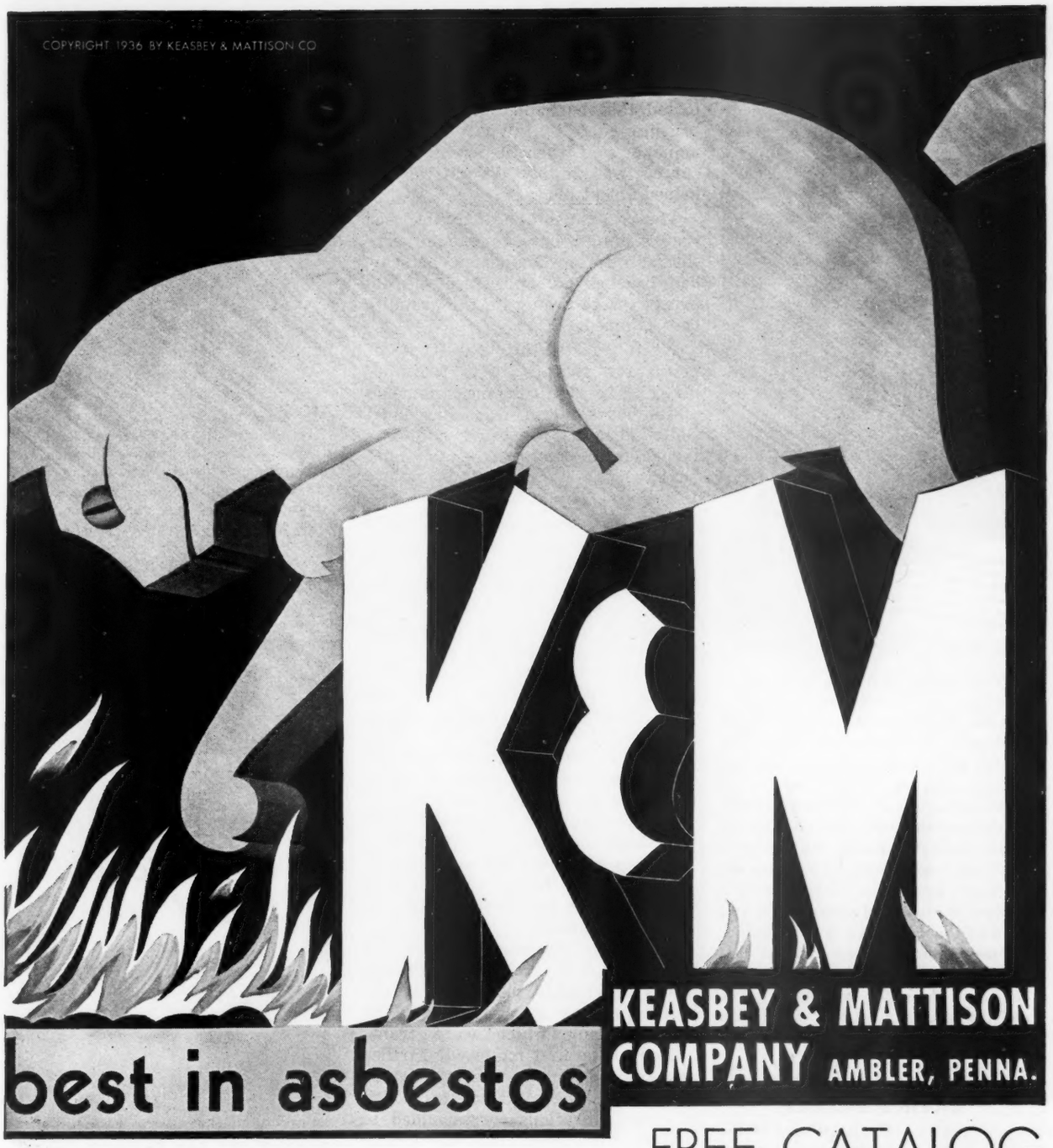
The motor behaved all right, but the new brushes sparked somewhat and wore down very quickly. It was assumed, therefore, that they were too soft for the purpose.

As a matter of fact the test proved exactly nothing, because the new brushes had a slightly lower resistance than the old ones. Naturally they took practically all the load, and were worked far above their proper current density. Excessive wear was inevitable. In this instance the difference in the resistance of the brushes happened to be slight. Had it been greater, there is little doubt that the commutator would have been seriously damaged.

Brushes of different grades should never be used at one time on the same machine. The above test should have been made first with the old and then with the new brushes.

An experiment which should have been carried out differently was made on an a.c. slipring motor that carried a heavy load and needed a new set of brushes. It was decided to increase the current-carrying capacity of the rotor brushes by using a graphite grade, instead of the carbon brushes with which the machine was equipped at the time. The old brushes were carefully measured and the new ones ordered accordingly.

In service, however, the new brushes frequently stuck in the



A complete line, specialized for the needs of each plant . . . K & M Asbestos Products offer you durability, uniformity and greater economy. More than 60 years of pioneering in the development of insulation and building materials . . . combined with the most rigid quality-control, from raw fiber to finished product . . . means unusual physical properties.

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The new K & M Catalog . . . illustrated and highly informative . . . will be sent to you promptly on request. **MAIL THIS COUPON**

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Please send me postpaid your new catalog "K & M Asbestos, Cement, Magnesia Products."

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How FAIRBANKS-MORSE *solved problem in carload shipping*

● When Fairbanks-Morse & Co. introduced its line of *Conservador* Refrigerators they wanted a safe, low-cost method of shipping them in carload lots. They put the problem up to Signode Packing Engineers who worked out a satisfactory method using Signode Bulk-Binding which provides reliable bracing at low cost. By its use the load is bound into large units which are free to shift slightly when the car stops or starts. Violent contact between the load and either the car end or wooden blocking is eliminated. Fairbanks-Morse & Co. estimates that the Signode System of Steel Strapping has saved them 50% in shipping costs, and the efficiency of each man in the shipping department has been increased 1 hour.

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The latest issue of The Signode Seal describes savings in shipping costs made by several companies. A copy will be sent to you by return mail on request.

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SIGNODE
Better Packing Headquarters

holders and failed to feed, thus causing sparking. The maintenance man said that more brush pressure was needed. His foreman angrily retorted that he hadn't measured the brushes correctly. What the plant manager said when the shutdown occurred was highly decorative, but helped not at all.

The real cause of the trouble was that graphite brushes expand considerably more when heated than carbon brushes do, and since the old brushes were a snug fit, the graphite ones jammed.

When substituting one type of brush for another it is therefore best to give the inside measurements of the box space in which they must slide. Then let the brush manufacturer do the worrying—*you* won't have to!

Excessive Sparking

For no apparent reason, a variable-speed, shunt-wound, interpole motor with field control often sparked excessively at its highest speed setting. Careful inspection of the field control switchgear failed to locate anything wrong, and the motor field and armature circuits also were found by testing to be free from shorts and open circuits. Brush rigging was in good condition and the brushes were bedding on the commutator with reasonable accuracy, in spite of being somewhat burned by the sparking.

The commutator, however, was in bad shape over most of its surface. Attempts to reduce the sparking by increasing the brush pressure succeeded only at the cost of increased wear and heating.

Eventually it was noticed that the trouble showed up only when the motor of another machine was operating, and set up vibrations in the wood flooring which were transmitted to the first motor. It further appeared that at one particular speed, the highest, the natural period of these vibrations corresponded to that of the motor that was giving trouble, setting up a mechanical resonance effect.

A slightly unbalanced core and worn bearings permitted the armature to vibrate excessively as the motor speed reached this natural resonance note. It is probable that if the resonance effect had taken place at some lower speed the real cause would have been promptly located. All in all, it was a case of too much evidence—pointing in the wrong direction.

Somewhat similar symptoms might be caused by a slightly bent shaft, electrical unbalance in the motor field due to unequal pole

(Continued on page 86)

CHICAGO RAWHIDE
Gears and Pinions

Take all the wear

IN every plant, in many machines, there are points where "Chicago Rawhide" Pinions will end destructive vibration and chatter, and silence nerve-racking noise. Make it a rule to check "Chicago Rawhide" for every gear application. Cut gears or blanks are available in any size or shape.

Write for new Gear Catalog and Manual

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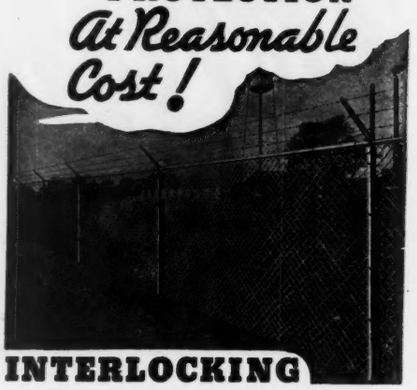
C MECHANICAL LEATHERS R

PROPERTY PROTECTION *At Reasonable Cost!*



INTERLOCKING *Chain Link* **FENCES**

Here's fencing that gives you what you want—sturdy, dependable protection for years. You have a right to expect years of service from an investment in property protection — and Interlocking Chain-Link fence gives you that.

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Interlocking Fence is rust-resisting, sturdy and durable. Expert erection service is available. Drop us a line, outlining your problems. We'll be glad to make recommendations and prepare estimates of the cost without obligation to you.

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Address Desk A Industrial Division

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ECONOMY

Distinguishes these Recorders

When you buy a recorder, you are not buying an instrument costing so many dollars. You are buying low-cost charts, essential records of machine-tool operation and process functions. These "operation pictures" can be obtained in no other way.

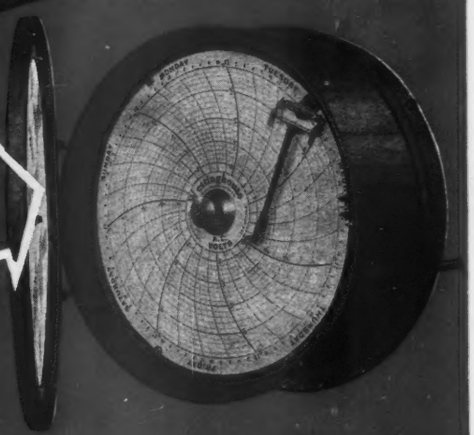
Particularly are Westinghouse types U and A recording voltmeters and ammeters inexpensive. With these instruments, the cost per record per machine is so low that it is hard to express even in cents.

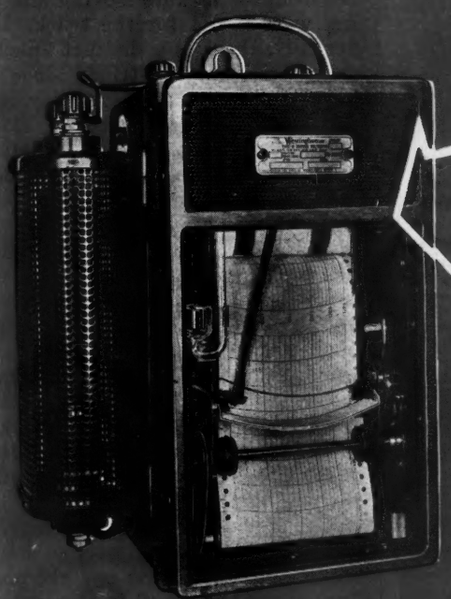
Made in both circular and strip-chart designs, U and A recorders are recognized as the unexcelled economic standards in graphic instruments.

CIRCULAR CHART

TYPE A—Either switchboard or portable with a 7 or 1-day easily replaced chart. Simple mechanically, yet assures excellent accuracy. Absence of delicate parts together with high-torque measuring elements assures an extremely sturdy construction. A synchronous motor simplifies the clock reduction gearing. Most important, the moderate cost of the type A permits its widespread use.

Ask for Catalog Section 43-415.





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TYPE U—Either portable or switchboard. With many thousands in service, the type U is recognized as the standard for voltage surveys, load analysis, and general industrial applications where graphic records are indispensable for economic operation. It makes possible the obtaining of important data which otherwise would not be taken because of instrument investment.

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Mills at Millbury, Mass., Johnson City, N. Y., and Jackson, Mich. Branches at New York, Philadelphia, Cleveland, Detroit, St. Louis, Chicago, Los Angeles, San Francisco, Dallas.

An Ultra-Modern Air Conditioning Plant for this Ultra-Modern Windowless Building

New Research Laboratory of Owens-Illinois Glass Co., Toledo—built entirely of translucent glass blocks—no windows.

This building without a single window—constructed entirely of Owens-Illinois glass blocks—is completely air conditioned by a Clarage System designed specially to meet the unique conditions encountered.

Cold well water is the medium employed for summer cooling and dehumidification, effecting a substantial saving in both first and operating costs as compared with the use of a direct expansion refrigerant. Clarage Vortex Control is installed on the Clarage supply fan. This patented device reduces fan horsepower by more efficiently regulating the volume of conditioned air delivered in accordance with zone needs.

Here is a typical example of Clarage resourcefulness and facilities in meeting *any* air handling or air conditioning requirement with satisfaction and utmost economy. If you have such a problem, write us!

SPECIFY CLARAGE for
COMPLETE AIR CONDITIONING
VENTILATION
HEATING
COOLING
MECHANICAL DRAFT
FANS & BLOWERS FOR INDUSTRIAL NEEDS

CLARAGE FAN COMPANY • Kalamazoo, Mich.
SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES

(Continued from page 82)

strength, a commutator that had become a little out-of-round, and so on, except that none of these conditions would necessarily depend on resonating with some other vibration set up elsewhere in the shop.

An out-of-round commutator may be caused by the slacking back of the V-ring clamp screws that hold the segments in place, by loose, high, or low bars, or by insufficient or improper seasoning during manufacture. If the speed of the motor is fairly high and the brushes are somewhat sluggish in responding to the changes in the level of the running surface, their rise and fall in the holders become a series of jumps accompanied by sparking.

It may be that all these instances of trouble should have been easily diagnozed. The chief difficulty with actual trouble-shooting is that things do not usually happen according to the textbooks. Often they are due to a combination of several causes which tend to produce symptoms that are misleading at first sight.

Brush troubles are no exception. That is why it is always advisable not only to look at the brushes, but also beyond them, for the real cause.

Piano Solos

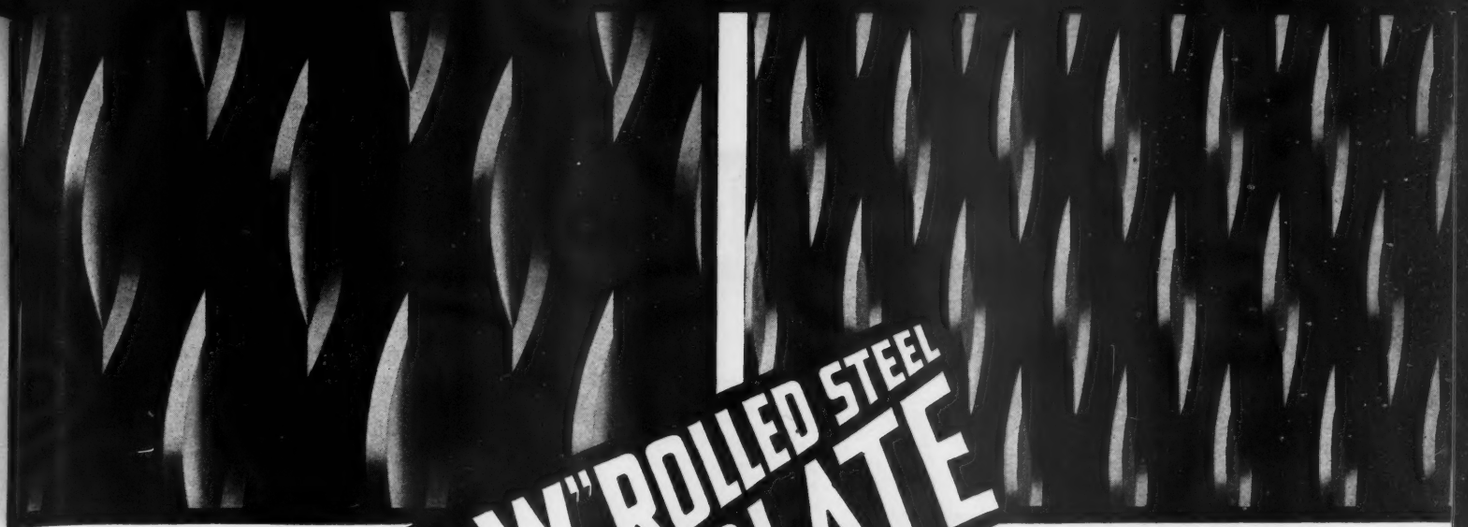
(Continued from page 43)

truck up, places the piano at a point where it is temporarily stored awaiting final inspection, sets it upright once more, and goes to his next job.

At least two men would have been required for all this moving and tilting were it not for the truck. Incidentally, there is a distinct knack to using the dumping truck, since tipping too fast or too slow may cause damage to the load.

Quite as interesting and useful is another piece of equipment known as the one-man truck. This is essentially a one-wheel lift truck. The piano, stored upright on the floor, has to be moved for inspection, final tuning, and so forth. As anyone knows who has ever attempted to push a piano, one man can easily supply enough motive power to move it on its own casters, but another person is required to keep it headed in the desired direction. This second person, for steering, is eliminated by the one-man truck.

The device consists of one 7-in. wheel mounted on a wooden handle slightly taller than an upright piano. Just above the wheel is a steel ledge to insert beneath the rear bottom of



"A.W." ROLLED STEEL FLOOR PLATE

Standard Diamond Pattern shown full size

Diamondette Pattern shown full size

Different conditions demand different patterns

Super-Diamond Pattern shown full size

"A.W." Super-Diamond pattern is engineered to give a completely safe tread from every possible angle under any condition. Best for all-around use in meeting varying conditions of pedestrian and vehicular traffic. Permits easy matching with minimum cutting waste.

"A.W." Standard Diamond pattern is the standard floor plate for applications subjected to severe traffic conditions, involving heavy loads where large, high projections are of advantage. And, as any other "A.W." Floor Plate, it is slip proof, oil proof, crack proof.

"A.W." Diamondette pattern is the ideal flooring for pedestrian traffic conditions, where underfoot comfort is important. Particularly suitable for small wheel trucking of light and medium loads. And it is practically noiseless.

OTHER "A.W." QUALITY PRODUCTS

Blue Annealed Sheets & Strip
Sheared Steel Plates
Billets, Blooms & Slabs
"Swede" Pig Iron

"A.W."-"70-90" Super Strength Steel

Write for new literature showing five "A. W." Floor Plate patterns to meet all needs, and giving complete engineering data. Immediate delivery in any of the five patterns, and prompt execution of special mill orders.

ALAN WOOD STEEL COMPANY

CONSHOHOCKEN, PA.

BRANCHES: Philadelphia, Pa., Fidelity-Philadelphia Trust Bldg.—New York, N. Y., 60 E. 42nd Street—Boston, Mass., 250 Stuart Street—Detroit, Mich., 3729 Crane Ave.—Los Angeles, Cal., 620 W. M. Garland Bldg.—San Francisco, Cal., 444 Market Street — Seattle, Wash., 401 Polson Bldg. — Houston, Texas, 110 Byrne Street.

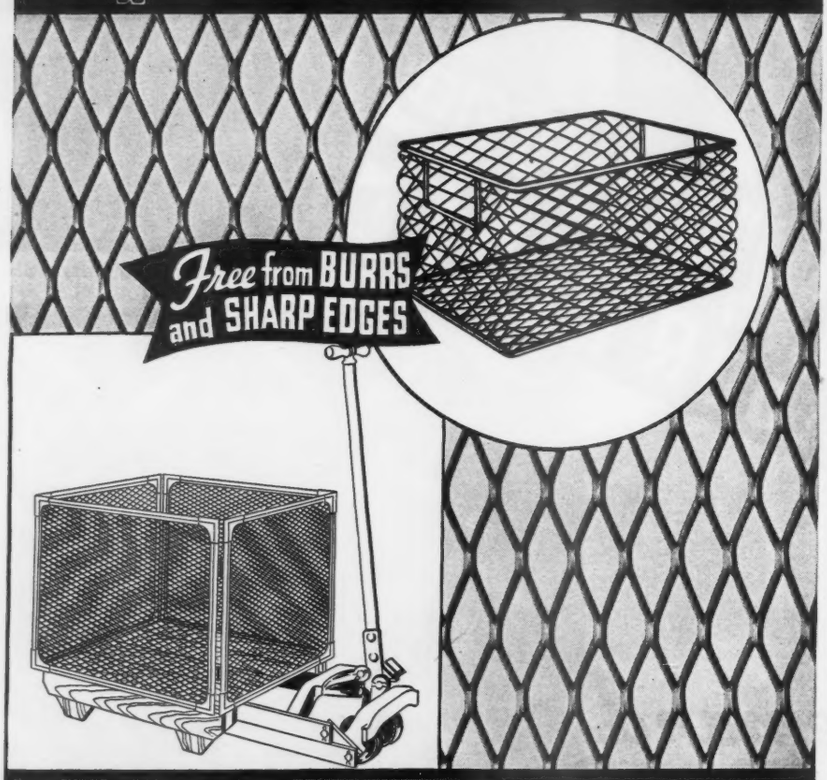
REPRESENTATIVES: Buffalo, F. E. Allen, Inc.—Pittsburgh, C. C. Poling Co.—Cleveland, J. F. Corlett & Co.—Chicago, A. M. Castle & Co.—Cincinnati, J. F. Corlett & Co.—Roanoke, Va., George M. Milliken, Jr., 303 Boxley Bldg.—New Orleans, Jones & Laughlin Steel Corp.—Minneapolis, R. E. Deutsche Co.—Montreal, A. C. Leslie & Co.

ALAN WOOD STEEL CO. ESTABLISHED 1826 "A.W." CONSHOHOCKEN, PA.

110 YEARS' IRON- AND STEEL-MAKING EXPERIENCE

Steelcrete

EXPANDED METAL

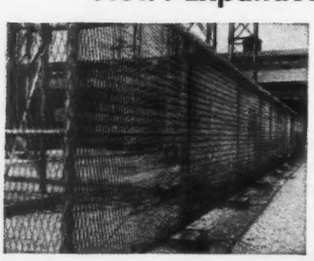


STEP UP FACTORY EFFICIENCY IN A HUNDRED AND ONE DIFFERENT WAYS

● Expanded metal is adaptable to a large number of industrial purposes. The fabric is quickly and economically fabricated into baskets, drying racks, trays, storage bins, lockers, machinery guards, window guards, partition enclosures, cat walks, etc.

Steelcrete Expanded Metal gives you the strength and durability of solid steel with all the advantages of open mesh construction. The Steelcrete Handbook—mailed on request—contains many valuable suggestions and full details of Expanded Metal applications.

New! Expanded Metal Fence



● Steelcrete Expanded Metal Fence for industrial enclosures is now available in standardized sections and complete with all accessories. The revolutionary features of this new type of fence are explained in the Steelcrete Expanded Metal Fence Catalog. Write for your copy.

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WHEELING, WEST VIRGINIA
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the piano, and this ledge is tied to a lever at convenient working height. The man moving the piano comes behind the instrument, slides the ledge beneath it, pushes down the handle, thereby lifting the piano off its two rear casters but leaving it resting on the two front casters.

A piano on its own four casters is not easily steered because the casters tend to swivel in all directions. But the single wheel of the one-man truck is fixed parallel to the length of the piano. Therefore it pretty well controls the direction, and the pusher can steer as well. It is not possible, of course, to push the piano in the crosswise direction because of the fixed wheel, but turns can be negotiated by making a wide arc.

Because the bulk of a piano's weight falls on the rear casters, caster breakage is bound to be cut down by use of this truck. To keep finish from being marred, it would be necessary to have an extra man on hand to do nothing but steer for the men who must move the pianos about occasionally, if this truck weren't used. And then only one piano could be moved at a time. As it is, the number of units in motion is limited only by the number of trucks available.

An Engineering School of Its Own

(Continued from page 47)

cial law, practical applied engineering mathematics, and practical applied thermodynamics.

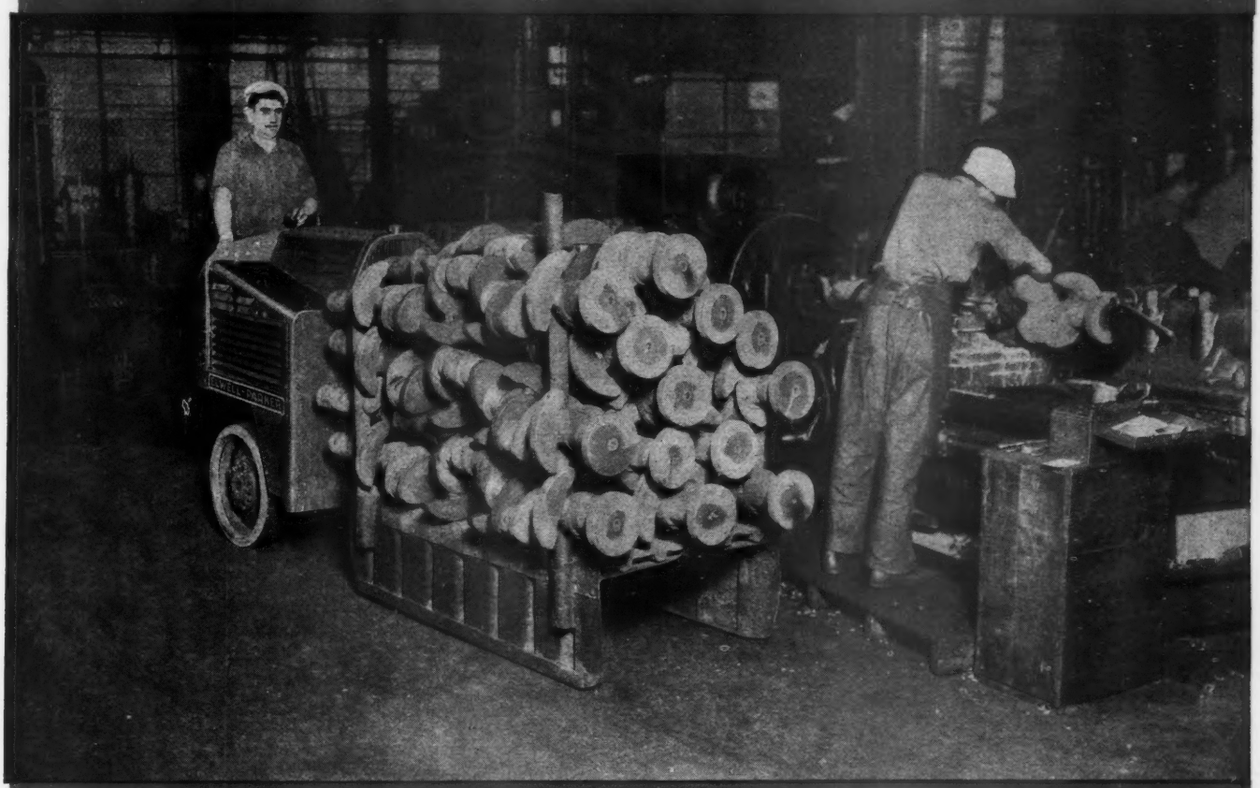
Upon completion of the course the men are graduated with an M.E. degree and absorbed by the department in which we think they fit best. In other words, we let them pick the type of engineering they like most—experimental, research, development, production, sales, or service.

Men Placed Correctly

This graduate school allows us to put honest-to-goodness research men on research projects, real experimental men on experimental projects. Doctor Timoshenko of the University of Michigan, in attempting to distinguish the one from the other, said:

"The experimental man plays around with something he already has; the research man is searching for new truths and hoping to find them. If you ask an experimental engineer to do a certain thing, he would present fundamental theories showing it was impossible. If you put the same question to a research engineer,

"Bottlenecks" ARE TO BE OPENED UP, NOT TOLERATED



Elwell-Parker *Gas Power* Truck delivering load of unmachined crankshafts to lathe. Load is spotted at machine, leaving aisle clear. Net weight of load, 5200 lbs. The Ohio Crankshaft Co., Cleveland, Ohio, owner.

A "BOTTLENECK" is the place in a plant where the flow of goods in process slows down and piles up to no good purpose, while succeeding operations are "starved." Of course that means unreasonably high costs.

You are looking down an aisle crowded with heavy traffic both ways, which *might* be a "bottleneck" but *isn't!*

Even with the heaviest loads to be transported from storage to machines to shipping department, an Elwell-Parker Gas Truck keeps passageways clear 24 hours a day.

"Bottlenecks" are *costly*—usually *preventable.*

Right now, when thousands of plants are at their busiest and profits *should* be the largest in years, there is danger that such slowing down may seriously curtail net earnings.

Are *you* harboring "bottlenecks"—those chiselers of the profits that belong to you? Widely-experienced Elwell-Parker Engineers can show you how to open them up with Truck, Tractor or Crane, *without changing your plant layout.*

Gas, Gas-Electric or Electric power is optional with Elwell-Parker Trucks. The Elwell-Parker Electric Company, 4323 St. Clair Avenue, Cleveland, Ohio.

New Type ELWELL·PARKER Trucks

ESTABLISHED 1893 • BUILDING POWER INDUSTRIAL TRUCKS SINCE 1906

3.6% of your employees do Cleaning Work

That's the average in industries according to a recent report.

Vacuum Cleaning with a Spencer System enables a few operators to do more work in less time and to perform cleaning work that should not be done by hand. Such as:

Cleaning ceilings and walls.
Reclaiming valuable materials.
Removing dangerous dusts.
Cleaning shipping boxes and the finished product.
Cleaning machinery.

Spencer Vacuum Cleaning Systems have been developed in a wide range of types and sizes with a large variety of vacuum tools that effectively eliminate the most obstinate industrial dirt and dust conditions.

Our engineers will suggest methods and show you how little it would cost.

SPENCER HARTFORD CENTRAL AND PORTABLE VACUUM CLEANING SYSTEMS

THE SPENCER TURBINE COMPANY, HARTFORD, CONN.

DUST doesn't bother this belt!

8" medium double-leather belt — driven pulley 24"—driver pulley 7"—15 H.P.—750 R.P.M.—24 ft. centers. Note slack operation made possible by Cling-Surface.

Because it's Cling-Surface Protected!

This belt treatment does not stay on the surface like ordinary "belt dressings." It quickly penetrates belts, surrounds every fibre with protective lubricant that keeps out dust, prevents drying or cracking, maintains the easy pliability that means extra years of service. Because of this extra value in Cling-Surface, one user reports a reduction of 60% in belting costs and actual cash savings as high as $7,000 annually.

Cling-Surface is the only belt treatment which both preserves drive belts and stops slipping so completely that belts can be run easy (slack) and still deliver full loads. Yet this scientifically-manufactured belt "food" costs no more than ordinary by-product "belt dressings." Why not start now to realize the economies Cling-Surface makes possible? Order from your mill supply distributor. Cling-Surface Company, 1058 Niagara Street, Buffalo, N. Y.

CLING-SURFACE
Preserves Power Belts—Prevents Slipping

he would no doubt reply: 'I don't know how—yet!'"

Our undergraduate school is an evening school in which about 1,000 men and women are enrolled. Subjects offered are high school preparatory or commercial work, mechanical engineering, mechanical drafting, body designing, and business administration. In addition there are many special classes such as public speaking, Spanish, and a better business English course for our export people.

All faculty members are Chrysler employees, and must be college men. Many of them hold doctor's degrees in their respective professions. No uition fee is charged. Books are sold at cost. Average age of the men in this school is 30 years. They come to us from all the Chrysler plants in the Detroit metropolitan area, and from Windsor.

A corporation that employs 70,000 people is bound to have a lot of latent talent unknown to anyone but the immediate boss of the department. This undergraduate school enables us to pick men for advancement who are sufficiently trained in some way to fit into work other than what they are doing at present. Many instances could be cited of men who have been moved up to better jobs—for which they get more money—when their talents became known through school activities.

Ground Portable Equipment, Too

(Continued from page 54)

very heavy currents will flow and relatively high voltages will be found across various points of the system, particularly in the ground section of it, where they may involve a considerable element of danger.

In view of the undesirable effect of such simultaneous faults and the difficulty of obtaining suitable protection against them, it is recommended that the system installation be given periodic testing and the best possible maintenance. Since the limited-ground-return system protects against the first line-to-ground fault, it is reasonable to assume that with this system a great deal of the danger of simultaneous faults will be removed.

With the scheme suggested in the foregoing the necessity for the maintenance of a ground return path of relatively low impedance will be apparent. This is best accomplished

"THEY'RE A CINCH TO INSTALL" Says This Electrician

"And Once They're In, You Can Forget About 'Em"

"I DON'T have to do a lot of monkeyin' around to install G-E magnetic switches," says this electrician. "Whoever designed them must have known what we electricians are up against."

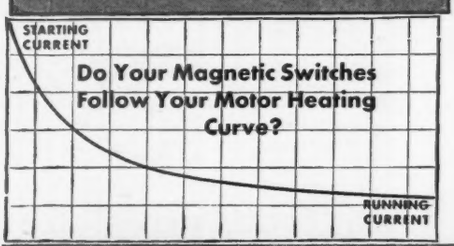
Well, this man should know—wiring switches is part of his business.

Certainly we try to build our magnetic switches to make installation as simple as possible. For instance, the cases are roomy enough to allow a man to work on the switch with a screw driver or pliers. And if he wants to remove the switch from its case, he has only to take out three screws. The terminals, likewise, are located in a convenient position, there are plenty of knockouts, and you can lift the arc chutes out with your fingers. That electrician is right—G-E magnetic switches are "a cinch to install."

But our magnetic switches will give you a lot of unique benefits after installation, too. As a matter of fact, they are the only devices of their type that will give you full overload-relay protection. This means that not only are your motors protected against harmful overloads, but also that the motors can continue in operation when the overload is harmless and of short duration. It's a simple relay, but it will follow closely the heating characteristics of your motor, and it will eliminate unnecessary shutdowns and save the time of your operators. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

FULL PROTECTION ALL THE WAY WITH G-E MAGNETIC SWITCHES



General Electric Company
Dept. 6—201, Schenectady, N. Y.

I should like to know more about G-E magnetic switches. Please send me your Bulletin GEA-841E.

Name.....

Company.....

Address.....

080-69

KOPPERS

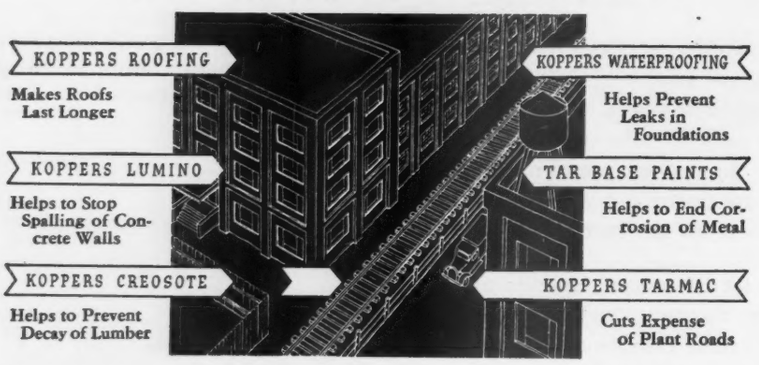
Can help prevent spalling of Concrete Walls

CONCRETE walls and buildings which are structurally sound but are disintegrating and becoming "sandy" at the surface, can often be saved from further weathering by one or two applications of LUMINO. Send for the folder describing this treatment.

LUMINO is also used on concrete and brick to seal them and make them moisture-repellent in damp locations; on interior walls to reflect more light; on walls of factories and industrial buildings to lessen the passage of heat; on tanks, stills, boilers, pipe insulation, etc., where heat conservation is important; on metal to lessen the danger of corrosion. Let us send you information on all these uses.

KOPPERS PRODUCTS COMPANY, PITTSBURGH, PA.

How Koppers Serves Factories



KOPPERS PRODUCTS COMPANY
Pittsburgh, Pa. F-5

Please send me information on: ☐ Koppers Roofings. ☐ Lumino for Spalling Concrete. ☐ Dampproofing and Waterproofing Foundations. ☐ Creosote. ☐ Tarmac for Plant Roads.

Name _____

Address _____

by the use of copper conductor of ample size with a minimum number of joints. Rubber-covered trailing cable should contain a heavy fourth conductor for the ground return circuit.

Dependence on the earth itself as a ground path is not to be recommended on account of the varying and somewhat undependable nature of ground contact connections. It is advisable to conduct routine tests periodically to make certain of the continuity and low resistance of the ground return circuit.

On account of the hazards to insulation presented by lightning disturbances it is essential that the power supply system be provided with the best type of lightning protective equipment available. It should be borne in mind that the low-tension distribution system may be affected by lightning disturbances originating on the high-tension system as well as by those which originate directly on the low-tension system. It is necessary, therefore, to use suitable lightning protective equipment on both the high- and low-tension systems.

If lightning disturbances are prevalent in the immediate vicinity of the machine, additional security may be obtained by means of a system of earthing-rods directly connected to the machine frame and located as close as convenient to it.

•

TRADE LITERATURE

(*Continued from page* 68)

Refractory Cement—Bulletin No. 321-A, describing Cast-Refract, a refractory cement.—Quigley Co., Inc., 56 West 45th St., New York.

Roller Chains—Book No. 1557, on line of roller chains and sprockets.—Link-Belt Co., 519 North Holmes St., Indianapolis.

Scales—Booklet, title "Industry at Work," showing applications of scales. Exact Weight Scale Co., Columbus, Ohio.

Speed Reducers—Bulletin 1200, with data on type CA, straight-line-drive, spur-gear speed reducer.—Abart Gear & Machine Co., 4834-36 West 16th St., Chicago.

Speed Reducers—Two bulletins: No. 1100, on parallel-shaft reducers; No. 2100, on right-angle reducers.—The Falk Corp., Milwaukee.

Steam Flow Measurement—Revised edition of the "Handbook of Steam Flow Measurement."—The Foxboro Co., Foxboro, Mass.

Steam Trap—Bulletin T-1732, title "What Makes the Yarway Steam Trap Work."—Yarnall-Waring Co., Chestnut Hill, Philadelphia.

Steel—General Data Book, Section 5, listing steel ready for immediate shipment.—Joseph T. Ryerson & Son, Inc., P. O. Box U, Chicago.

Stoker—Catalog No. SU-5, on CE-Skelly stoker unit for boilers up to 400 hp.—Combustion Engineering Co., Inc., 200 Madison Ave., New York.

Switches—Bulletin GEA-1522C, describing CR1062 manual motor-starting switches.—General Electric Co., Schenectady, N. Y.

for Heavy Overhung Loads . . .

Philadelphia

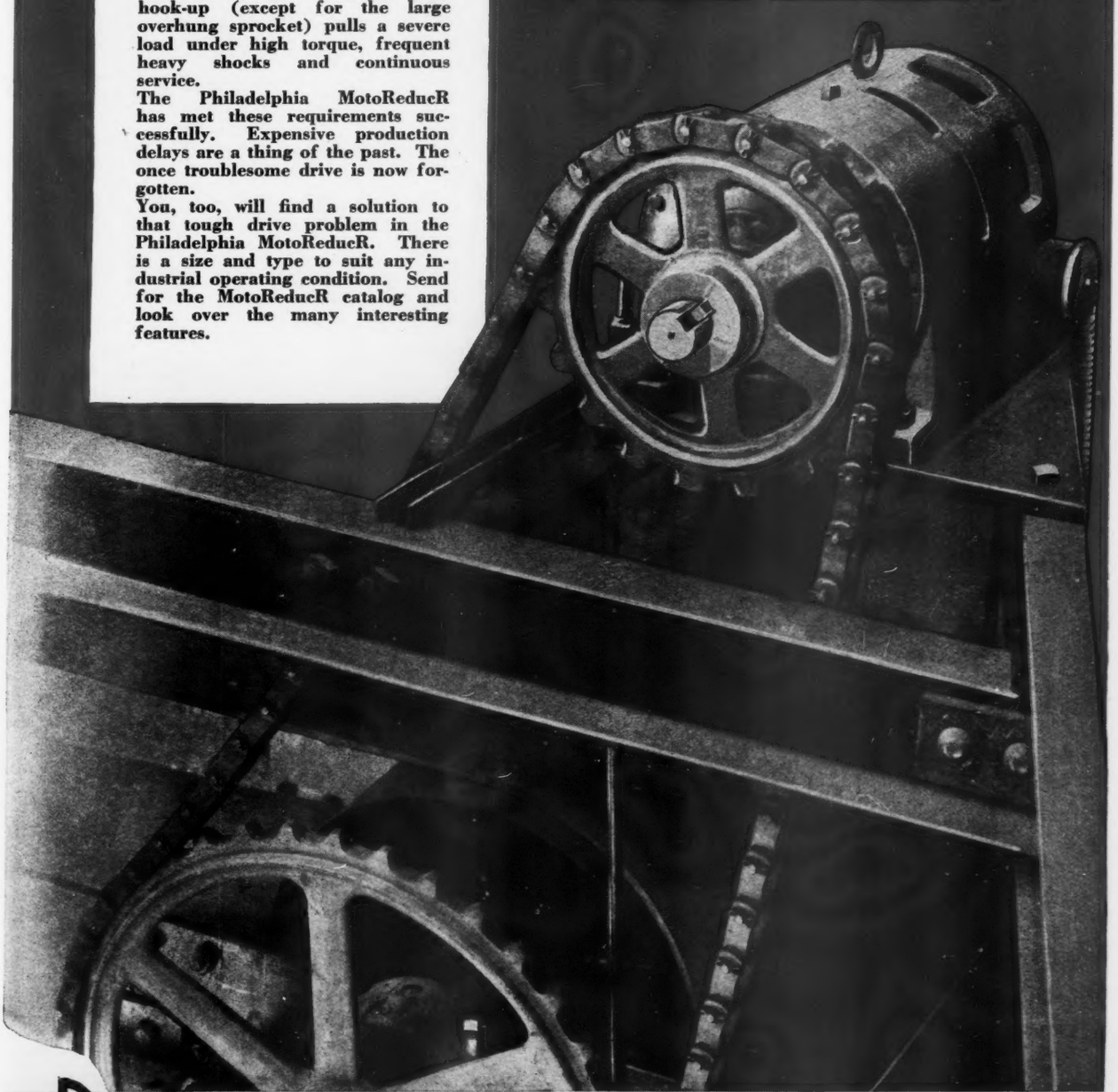
MOTOREDUCER

Here is a drive that has whipped many a speed reducing device into discard.

On several ore conveyors in the same plant, this harmless-looking hook-up (except for the large overhung sprocket) pulls a severe load under high torque, frequent heavy shocks and continuous service.

The Philadelphia MotoReducR has met these requirements successfully. Expensive production delays are a thing of the past. The once troublesome drive is now forgotten.

You, too, will find a solution to that tough drive problem in the Philadelphia MotoReducR. There is a size and type to suit any industrial operating condition. Send for the MotoReducR catalog and look over the many interesting features.

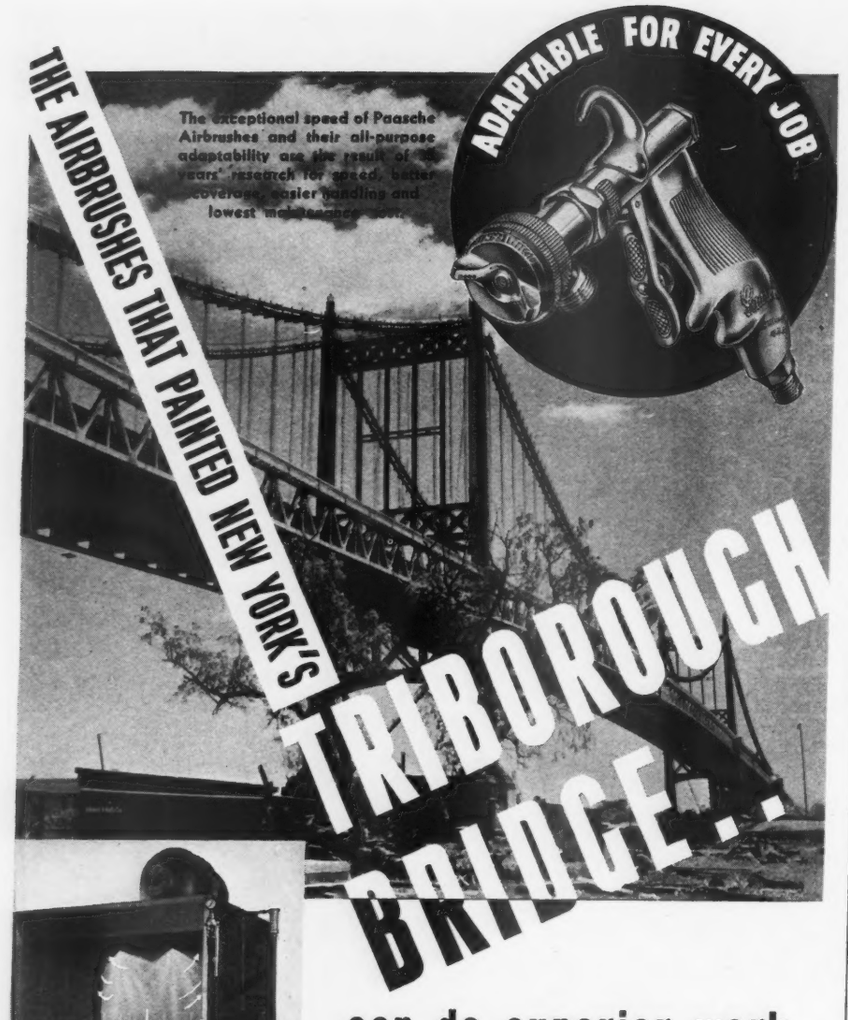


PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

Main Office and Plant
Erie Avenue and G Street, Philadelphia, Pa.

Branch Sales and Eng. Offices
New York and Pittsburgh


ADAPTABLE FOR EVERY JOB
The exceptional speed of Paasche Airbrushes and their all-purpose adaptability are the result of 35 years' research for speed, better coverage, easier handling and lowest maintenance cost.
THE AIRBRUSHES THAT PAINTED NEW YORK'S
TRIBOROUGH BRIDGE...

Booths: Galvanized steel booths of standard height in 13 widths, 2 to 30 feet. Type F66 shown here features a water curtain at the back for the constant removal of solids.

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Rubbing Machines: Airsanding, airrubbing, airpolishing machines are used throughout industry for fine finishing jobs—from the roughest casting to the finest mahogany and marble.

can do superior work for you ***at less cost!***

The Paasche Company pioneered scientific automatic airfinishing and aircoating, speeding production and reducing the amount of material required. Today every product of mass production that calls for coating—from lead pencils to Triborough Bridges is finished with Paasche Airbrushes.

Consider the variety of jobs listed here: painting 2160 golf balls an hour; striping two or three colors on chinaware; simultaneously enameling an auto accessory at the rate of 600 pieces per hour.

These processes are widely different and no manufacturer's problem is exactly the same but our wealth of experience on nearly every imaginable product is at your service. Our engineers can help you select the airpainting or aircoating equipment which will reduce your production time while cutting material and labor costs.

Ask us to describe an automatic airfinishing installation we have made in your industry.

Paasche Airbrush Co.

1901 DIVERSEY PARKWAY . . . CHICAGO, ILL.

Thermometers—Data Book No. 210, on line of recording thermometers.—Republic Flow Meters Co., 2240 Diversey Parkway, Chicago.

Tools—Catalog No. 36, showing complete line of hand tools.—Bonney Forge & Tool Works, Allentown, Pa.

Transformers—Two bulletins: No. 180, on distribution transformers; No. 181, on power transformers.—Wagner Electric Corp., 6400 Plymouth Ave., St. Louis.

Truck Casters—Catalog No. K25, on truck casters and materials handling equipment.—Bond Foundry and Machine Co., Manheim, Lancaster County, Pa.

Trucks.—Circular No. 220, showing floor trucks of several types.—Lewis-Shepard Co., 175 Walnut St., Watertown, Mass.

Unit Heater—Bulletin No. 46-E-1, on Kroytype unit heater.—Carrier Engineering Corp., Newark, N. J.

Valves—Bulletin, describing design, construction, and operation of automatic valves.—Davis Regulator Co., 2546 South Washtenaw Ave., Chicago.

Ventilator—Catalog, on rotary, suction-type roof ventilator.—American Larson Ventilating Co., Pittsburgh.

Vibration Dampers—Bulletin No. 53-C, on vibration isolation by means of steel springs.—The Korfund Co., 4815 32d Pl., Long Island City, N. Y.

Water Meters—Bulletin M-975-B1A, on water meters for cold water services.—Worthington-Gamon Meter Co., Harrison, N. J.

Welding—Booklet, title "Lower-Cost Manufacturing by Shielded Arc Welding."—The Lincoln Electric Co., Cleveland.

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BOOKS

DRILLING AND SURFACING PRACTICE

Fred H. Colvin, Editor, *American Machinist*, and Frank A. Stanley, Editor, *Western Machinery and Steel World*. 417 pages and index, illustrated. $4.

A complete guide for shop executives, foremen, machinists, and apprentices having to do with drilling, reaming, tapping, planing, shaping, slotting, milling, and broaching of metals, plastics, and other materials.

COMPANY SICKNESS BENEFIT PLANS FOR WAGE EARNERS

Industrial Relations Section, Department of Economics and Social Institutions, Princeton University, Princeton, N. J. 72 pages, bibliography. $1.50.

Analyzes the three main types of company sickness benefit plans and summarizes its findings. Reference material for concerns who are conducting or plan to institute sickness benefits for employees.

•

ON THE CALENDAR

OCTOBER

5-10, Fourth Annual Industrial Materials Exhibit, New York. Don Masson, Bakelite Corporation, 247 Park Ave., New York.

19-23, National Metal Congress and Exposition, Cleveland. W. H. Eisenman, National Secretary, American Society for Metals, 7016 Euclid Ave., Cleveland.

19-23, Seventeenth Annual Meeting, American Welding Society, Hotel Cleveland, Cleveland.

NOVEMBER

18-20, National Foreign Trade Convention, Chicago. James A. Farrell, Chairman, National Foreign Trade Council, 26 Beaver St., New York.

18-20, Thirty-Seventh Annual Convention, International Acetylene Association, St. Louis. H. F. Reinhard, Secretary, 30 East 42d St., New York.

30-December 4, Annual Meeting, American Society of Mechanical Engineers, New York. C. E. Davies, Secretary, 29 West 39th St., New York.

30-December 5, Twelfth National Exposition of Power and Mechanical Engineering, Grand Central Palace, New York.